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Transplanting Rolls-Royce Methods to the U. S.

The Problem of Duplicating Accurate Work in Another Country—Care in Selecting Materials and in Workmanship—Operation Drawings That Eliminate Mistakes

By Fred H. Colvin
Editor, *American Machinist*

TRANSPLANTING a business from one side of the Atlantic to the other is not an easy task at best. But establishing a branch factory may be even more difficult when all phases are considered. In the first instance, you can take the personnel, the tools, fixtures and gages, and manufacture as before with only the handicap of new environments. In the second place, you can only transplant part of the personnel from the home plant and practically no tools, fixtures or gages.

FIG. 1. STOCK BINS AND VERTICAL TURRET LATHES

You must establish a new plant, secure equipment which will give duplicate product, and train men to secure commercial interchangeability with the product of the parent plant. And when the product is designed with the idea that nothing is ever quite good enough, the securing of tools, fixtures and gages, and the training of men is doubly difficult.

Such, in brief, was the problem which confronted the management of the Rolls-Royce Co. of America, in establishing its plant at Springfield, Mass. Handicapped still further by beginning work when all of our shops were still crowded with the aftermath of war work, when accurate tools, fixtures and gages were more difficult to secure than they should have been, the organization is to be congratulated on its progress. For, beginning with nothing but its personnel, drawings from the home plant, and models of the various parts, cars with completed chassis are now coming through the erecting shop in a satisfactory manner.

The First American Chassis

The first American chassis was completed in January and has been thoroughly road-tested in every way. It is so nearly a duplicate of its English mate that not even those who are thoroughly familiar with the car can tell them apart except for certain small earmarks which have nothing whatever to do with either the appearance or quality. And every essential part is interchangeable on these two cars.

To satisfactorily prove to themselves that the American and English products are interchangeable, a test was made in which an English chassis and an American chassis were assembled and the units and parts interchanged to the absolute satisfaction of the inspection department.

It should be stated that the parent firm, recognizing the importance of immediately attaining and maintaining the existing standards, selected for every department a staff of supervisors possessing expert knowledge of the Rolls-Royce manufacture and standards. The machine equipment is American throughout with the exception of the cam grinding machine which was built in Derby, England, because at the time everyone in this country was too busy to build a single special machine for them. This machine is of special design to grind the peculiar reverse curve cam used on the Rolls-Royce motor. The equipment of the Derby plant is also largely American, however, so that this is no departure and the shop executives know exactly what results can be expected from the different machines. Beginning with only blueprints and models of the main parts of the car, tools, fixtures and gages have been secured, a supply of material has been made available and work is actually under way in a satisfactory manner.

A Word About the Personnel

The works manager, George Bagnal and his assistant, J. E. Poole, are broadminded men and thoroughly practical mechanics. Both credit the foundation of their work and their desire to better mechanical methods, to the *American Machinist*, which years ago, became the inspiration to forward looking mechanics of Great Britain and other lands. They realize, perhaps more

FIG. 2. GENERAL VIEW OF MACHINE SHOP

thoroughly than some of us on this side of the water, that mechanics know no nationality, and no creed save excellent workmansihp.

It is particularly gratifying to note the harmony which prevails in the personnel, the eagerness of all to excel, if possible, the product of the parent plant, and the willingness to credit the working staff with their full share in the results.

Showing Why Accuracy Is Necessary

Some of the shop methods are of particular interest, and in order to appreciate just what these methods mean in the way of expense as well as results, we must bear in mind the small output of approximately one car per day or eight per week as a maximum. Production is never forgotten, however, and a bonus is paid for a good output. Prominent notices inform the men that a bonus is never cut without an entire change of method. But quantity is not the prime object. Shop mottos or slogans, prominently posted, urge the men to think about their work, others urge them not only to equal the Derby quality, but to beat it.

Every effort is made to let each man know just why certain things are done and why such great care is necessary. Men are shown what part their work plays in the construction as a whole. In addition, special classes are held at which engineers, tool designers, and others tell the men the whys and wherefores of the various requirements. Another innovation taken from the shop in Derby is the introduction of a half hour smoking period in both forenoon and afternoon. This does not mean a cessation of work, but that smoking is permitted at the machines during this period.

The problems involved in producing these cars are unusual in a number of ways. The construction of the original car must be followed in every detail. This involves special material and special methods. It involves the use of forgings where our practice is to use pressed steel fittings or malleable castings as being entirely satisfactory. It necessitated the making of thousands of special tools, fixtures and gages, which must turn out a product that will interchange with the car made in Derby. For in spite of a limited production, this is a machined and not a hand-made product as is usually supposed.

Not Hard Work But Good Machining

No scraping is done on the bearings but the machining probably takes fully as much time because of the painstaking care to secure the best possible results. And no matter what some may think as to the wisdom of the selection of some of the material used, there can be no question as to its quality, its dependability or the service it renders. Nor must we forget that the makers guarantee extends over a period of three years instead of three months.

The experience of the engineers of the Rolls-Royce Co. in securing absolutely dependable steels and the justification of their faith that they could secure in this country, the high-grade demanded, is very gratifying. It also proves them to be engineers of vision, shows further that they were not handicapped by national prejudices. Their problems and the solutions are of value to all users of high-grade steel.

Among the personnel is a steel expert who is versed not only in the theory but in the actual production of steel. He has been through the steel mills as a worker and knows the various steps in the process. This man watches the steel as it is being made and rolled. He watches it as it is forged into crankshafts, connecting rods, and other parts, and no steel is shipped from the

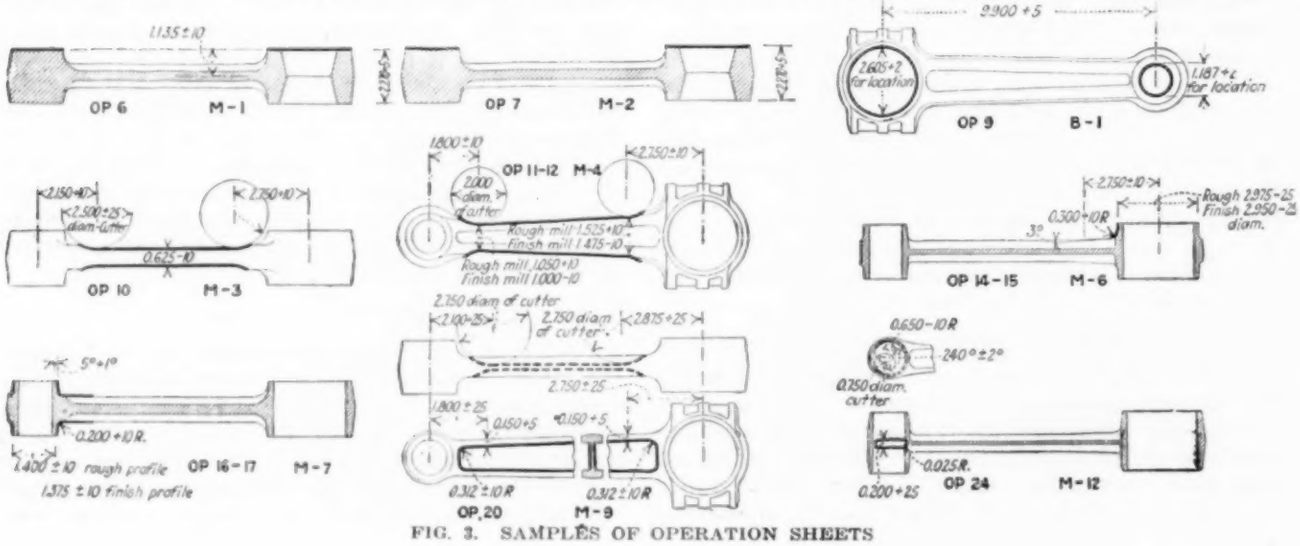


FIG. 3. SAMPLES OF OPERATION SHEETS

mill or forge into the plant without his mark of approval. This saves much in the way of freight on rejected parts and the time lost by partially machining defective material.

One of the difficulties was the presence of hair lines on the finished surface of forged parts. So numerous tests were made to see how deep these lines or cracks were. After many experiments, it was found that the lines usually disappeared within an eighth of an inch of the surface. Individual lines are usually only a few thousandths deep and these all seem to be confined to the outer eighth of an inch of a good forging. So crankshafts and other parts are made large enough to allow for the removal of considerable material and with it, any hair lines which may exist in the original forging. For while it may not be known positively that these hair lines cause a break, they are possible beginnings of fracture and are not tolerated.

The large amount of metal removed will be noted in the machining operation, particularly in the case of crankshaft and connecting rod. The crankpins of the former for example, are reduced from 2¾ to 2½ in. by grinding, in several stages, and hair line difficulties have been eliminated in this way.

Inspection and Test of Forgings

In the case of forgings which are not machined all over, as with the steering knuckle, these are first sandblasted so as to remove the scale, and are then filed up by hand in order that any small surface crack can be more readily detected. Hand filing has been found more effective than grinding or buffing, on account of being less liable to close an existing hair line. All forgings have a coupon attached for testing purposes and forgings are given 100 per cent inspection in this way. All members of the steering gear on every car, from the steering knuckle to the connecting bolts or pins, are tested for hardness, soundness and strength. In the case of steering pin or bolt connections, the coupon is left on each end when the part is being machined. One of these coupons is used for testing the tensile strength and the other the case-hardening and heat-treating. In the making of parts which are to be case-hardened locally, they have found that the older method of case-hardening the whole piece and then turning off the portions which are to be soft, has proved the most satisfactory. Copper plating and similar methods have given way to the older practice.

Blueprints and Models

The method of handling work in the shop involves the use of both blueprints and models. The blueprints are arranged by operation and in such a way as to avoid confusing the operator on his particular work. This method is illustrated in Fig. 3, where nine operations on the connecting rod have been selected to illustrate the plan used.

The symbol in the corner indicates the particular kind of operation, those with an *M* representing milling and the *B*, boring. The first operation shown is the rough milling of one side of the rod. Both ends are made of the same length for convenience in machining. This avoids making steps on any of the fixtures and the large end is afterward faced down to its proper thickness. As will be noted, there is only one dimension on *M1*, showing the distance from the center line of the rod to one face, with a tolerance of plus or minus ten thousandths of an inch. In operation *M2*, the other side is milled, locating from the first side and the tolerance is plus five thousandths.

All tolerances are given in thousandths so it is unnecessary to use the decimal point in any of these cases. Here again, only the dimensions which interest the operator on the particular job are given. Operation *B1* bores both ends of the rod with a plus tolerance of five thousandths. Here again, the only dimensions shown are the two diameters and the center distance. Going to the next milling operation we find all the necessary dimensions for roughing the sides of the rod, the dimensions showing the limit of travel on the milling cutter in each direction.

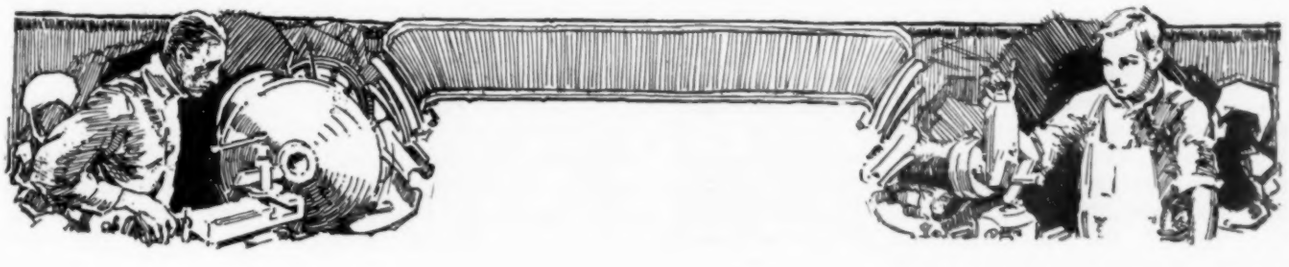
Eliminating Chances of Error

Other milling operations are shown in the remaining diagrams, in each instance, only the essential dimensions being given. This keeps the operator's mind entirely on his particular operation and gives no excuse for reading a dimension which belongs to some other operation. In the last operation shown, the small milling cutter cuts an oil groove about three-fourths of the way around the small end of the rod. This distributes the oil around the outside of the piston-pin bushing. This bushing has oil holes drilled through it and as the bushing floats between the pin and the rod, this insures lubrication on both sides. Although not shown in any of the operations in Fig. 3, oil is conducted from the main bearing to the small end of the rod by a small copper pipe which lies in the channel on one side.

Blueprints Augmented by Models

In addition to the operation blueprints, the toolroom is supplied with models of the main parts of the car in their various stages of completion. When the operator gets his blueprint he also draws the corresponding model from the toolcrib and keeps that beside his machine so as to give him a visual evidence of the operation he is to perform.

While these models are perhaps not entirely necessary they are often a great help when men are not thoroughly familiar with blueprints, and are particularly helpful in machining the parts for an entirely new product. The system has much to commend it on some classes of work, even though it is a return to a method very generally used in the days before blueprints became common in the shop.



Design of Helical Springs

A New Point in the Design of Helical Springs — Method Developed Particularly for Small Springs—Chart for Quick Determination of Values

BY JOSEPH KAYE WOOD
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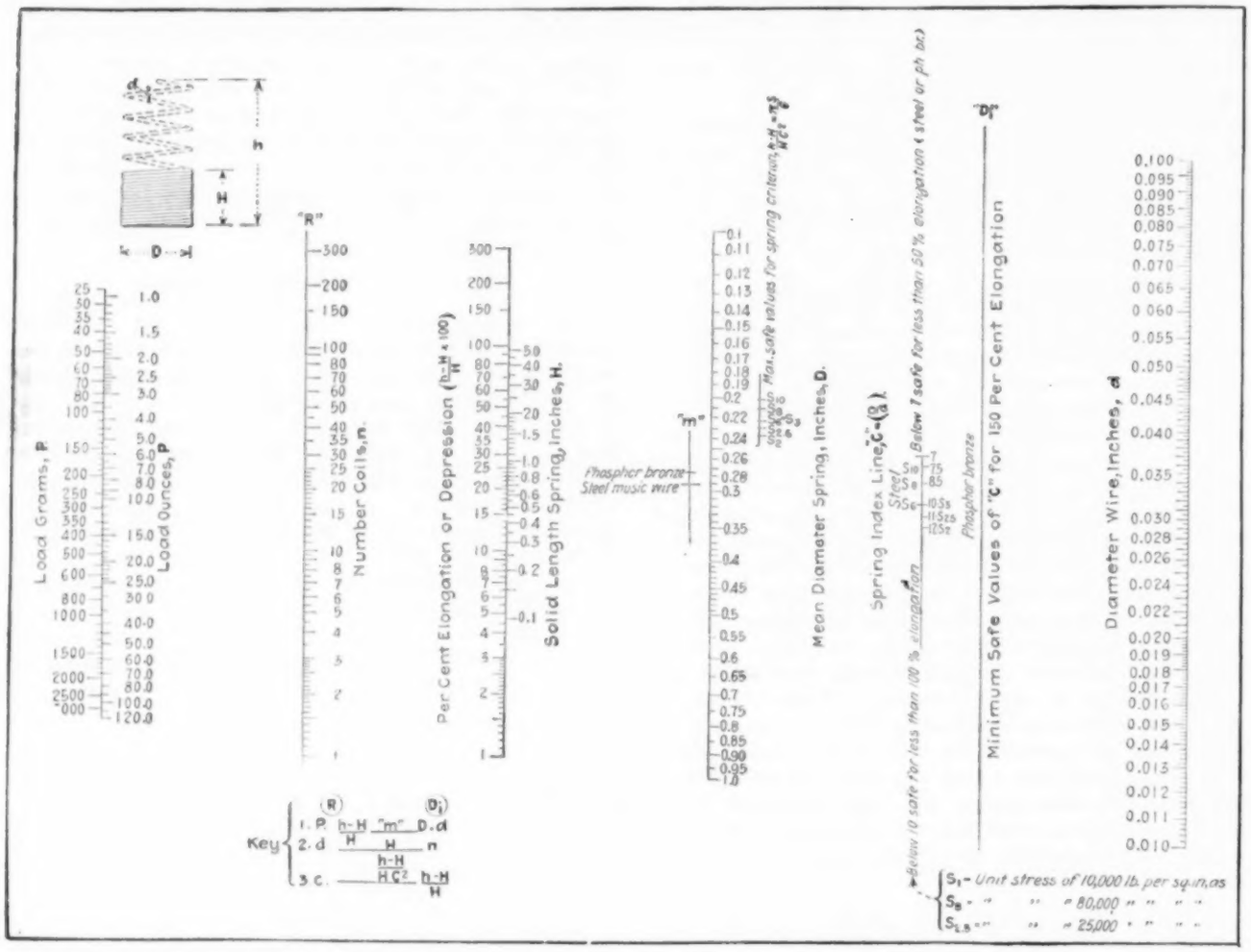
HELICAL spring design from the theoretical standpoint appears to many designers to be a very complex matter, in fact, quite a few will frankly admit that they design springs not by careful calcuiation, but instead by an approximate estimation of the varicus dimensions involved On the other hand, some designers attempt to design springs by careful computation, but complain of the laborious work involved.

I have had occasion to design and investigate many small helical springs, which led me to realize the urgent need of some systematic arrangement of the many factors that enter into the design of these springs. Consequently, I have written the following article, bringing out an apparently new fact and several corollaries to it, which simplify the design of helical springs both small and large. In this connection, I found it convenient to create two new terms: "spring criterion" and "material index." The fact spoken of is as follows: "That the spring criterion must not exceed the material index in order that the helical spring in question will be able to safely carry the maximum load as computed from the ordinary deflection formula." In symbols it is as follows:

$$\text{(Spring Criterion)}\quad \frac{h-H}{HC^2} < \frac{\pi S}{G}\quad \text{(Material Index)}$$

This condition was obtained by equating the maximum allowable work applied to the spring to its resilience, the resilience of a spring being the maximum amount of useful work that can be recovered from it after the removal of the load. The mathematical derivation may be seen at the end of this article. Thus, this


Load Grams, P
Load Ounces, P
"R"
Number Coils, n.
Per Cent Elongation or Depression (h-H/H × 100)
Solid Length Spring, Inches, H.
"m"
Phosphor bronze
Steel music wire
Mean Diameter Spring, Inches, D.
Spring Index Line, C=(D/d)
Steel
Phosphor bronze
Minimum Safe Values of "C" for 150 Per Cent Elongation
Diameter Wire, Inches, d
Key
1. P h-H/H "m" D.d
2. d h-H/HC² n
3. C h-H/H
S1 = Unit stress of 10,000 lb. per sq.in.as
S2 = " " " 80,000 " " " "
S1.5 = " " " 25,000 " " " "

Instructions for Operation: Pass a line through the load "P" and the corresponding "Elongation or Depression," from the intersection on the line "R" pass a line through the proper point on line "m," and the prolongation of this line gives an intersection on the line "Di" (Key 1). A line through this point gives the value of "d" for a certain "D." In a similar way "n" is found, according to Key 2. By an inspection of the intersection of the "D"-"d" line on the "Spring Index" line, we note if the spring is safe. This can be verified by Key 3.

FIG. 1. ALIGNMENT CHART FOR DETERMINING SPRING SIZE

fact furnished a basis upon which to formulate a simplified method of procedure in helical-spring design, in which procedure a convenient parallel-scale chart is used. It also includes three important corollaries to the above condition (designated by Roman numerals) which if more generally known would be very useful in themselves. Although I have had small helical springs in mind when writing this article, upon examination I find that with the exception of the paragraph on material it applies to springs of all sizes.

Items To Be Considered

In designing a helical spring, we may classify the important considerations into three parts:

1.—Requirements of the spring:
- 1.1 Load (P)
- 1.2 Percentage elongation or depression $\frac{h-H}{H} \times 100$

2.—Dimensions of the spring:
- 2.1 Spring diameter (D)
- 2.2 Wire diameter (d)

3.—Material of the spring:
- 3.1 Modulus of elasticity for torsion (G)
- 3.2 Maximum safe fiber stress (S)

1. The requirements of a spring must necessarily be known from the requirements of the mechanical device to which the spring is to be applied.

2. The ratio of the spring diameter to the wire diameter, called the "spring index" (C), is very important, and it is found to be good practice not to have this value less than 7. Consensus of opinion as to what the minimum value should be varies between 5 and 7.

3. The material selected for a spring is the most important and fundamental consideration, as a material having as high an elastic limit as possible, and preferably a low value for the torsional modulus of elasticity, gives the most serviceable helical spring. Medium carbon steel of high strength with a low phosphorus and sulphur content should invariably be used in making up springs, but if the surrounding conditions are severely corrosive, phosphor bronze containing a small amount of tin and phosphorus should be used. However, under less severe corrosive conditions, steel springs may be copper plated to avoid using phosphor bronze. The process of drawing wire gives additional strength to the material used on account of the hard surface skin formed, the strength being exceptionally great for small wire, because of the greater ratio of the surface of a cylindrical solid to its cross section as the diameter decreases. Due to this surface structure, the fundamental formulas as regards torsional deflection and maximum safe working load may not hold exactly; nevertheless, as we lack sufficient data on spring material to supply constants for an empirical formula, we must use these formulas.

The capacity formula can be taken care of by assigning a large factor of safety, varying according to the severity of service to which the spring will be subjected. It has been found in small helical spring design, that for high-grade steel music wire of 0.050 in. diameter or less, a value of 100,000 lb. per square inch for the maximum safe fiber stress (S) allows a sufficient factor of safety for ordinary service conditions. For severe service conditions, the engineer's judgment will have to supply the value of (S) or it is recommended that the values in the following table be used for this purpose. By conditions of service is meant the frequency of operation of the spring and severity of sudden shocks or vibrations which may occur, and does not take into account atmospheric conditions. As far as known, there is no information which shows the definite relation between the frequency of operation and the degree of fatigue. The value of "G," the torsional modulus of elasticity, is universally accepted as 12,000,000 lb. per square inch for steel, and for phosphor-bronze wire 6,000,000 lb. per square inch, as shown in the accompanying table.

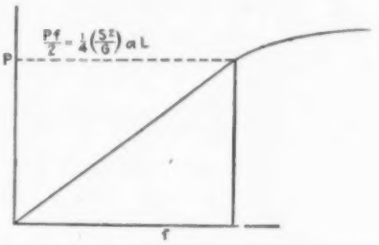


FIG. 2. STRESS-STRAIN DIAGRAM FOR SPRING

Formulas Used

The two following formulas are the principal ones used for the design of helical springs. The first one, known as the "Deflection Formula," depends upon the elastic property of the material, and the second, the "Capacity Formula," depends upon the strength and elastic limit of the material. The fundamental expressions of these formulas are derived in any book on mechanics, particularly Merriman's "Mechanics of Material," and also at the end of this treatise.

$$\frac{h-H}{H} = \frac{P}{2G} \times \left(\frac{D}{d}\right)^2 \times \frac{D}{d^2} \qquad \text{(Deflection formula)} \qquad (1)$$

$$P_c = \pi \times 2S \times \frac{d^2}{D} \qquad \text{(Capacity formula)} \qquad (2)$$

In addition, $N = H \div d$ (Number of spring coils)

The symbols in these and in the formulas given later have the following meanings:

P = Maximum operative load in ounces
P_1 = Initial load in ounces
P_c = Maximum safe working load in ounces
h = Maximum length in inches
h_1 = Initial length in inches
H = Solid length of spring in inches
D = Mean diameter of spring in inches
d = Diameter of the wire in inches
N = Number of coils in the spring
G = Torsional modulus of elasticity in pounds per square inch
S = Maximum safe fiber stress in pounds per square inch

$\frac{\pi S}{G}$ = Material Index

C = Spring Index = $\frac{D}{d}$

$\frac{h-H}{H} \times 100$ = Percentage Elongation or Depression

$\frac{h-H}{H} \times \frac{1}{C^2}$ = Spring Criterion < Material Index

Formula (1) should be used to find the diameter "d" of the wire for the spring which will satisfy the requirements of pressures and corresponding elongations or depressions. In lieu of the capacity formula (2), the following facts will be found more useful.

1. In order that a spring, as designed by the deflection formula (1), shall be safe for the maximum load, the Spring Criteron should not exceed the Material Index. In other words, no more work should be applied

to a volume of wire by a load P than what the material is able to give out again as useful work, this internal energy being known as the resilience of that particular

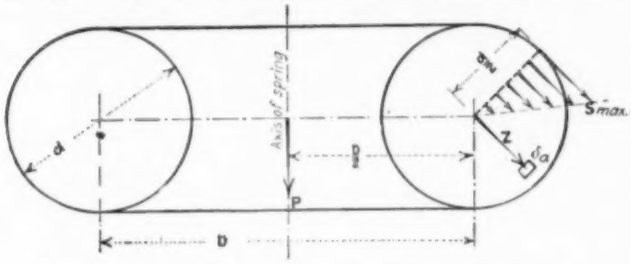


FIG. 3. SECTION OF SPRING FOR DETERMINING CAPACITY FORMULA

volume of material. See mathematical derivation at the end of this article.

2. For steel music wire ($S = 100{,}000$ lb. per square inch) under ordinary conditions of service, the value of the Material Index is equal to 0.026, and for phosphor bronze ($S = 30{,}000$ lb. per square inch) the Material Index is equal to 0.016, which permits us to make the following statements provided the grade of material is as herein specified.

I. A steel spring whose Spring Index is greater than 7.5 will be safe for the maximum designed load under ordinary service conditions, provided that it is not elongated or depressed more than 150 per cent.

II. A phosphor-bronze spring whose spring index is greater than 7.5 will be safe for the maximum designed load under ordinary service conditions, provided that it is not elongated or depressed more than 100 per cent.

III. Any steel or phosphor-bronze spring, with a spring index greater than 7, under any condition of

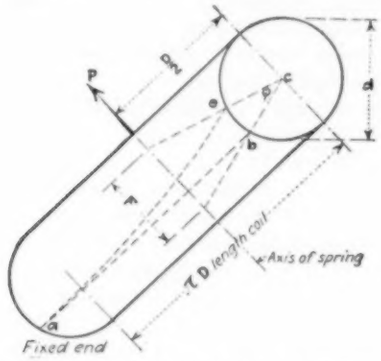


FIG. 4. CONSTRUCTION FOR DETERMINING DEFLECTION FORMULA

service, but not elongated nor depressed more than 50 per cent, is safe for the maximum load designed.

Similar limits for other conditions of service are given in the accompanying table.

Solution by Means of Chart

As the computation work involved for the foregoing formulas is rather great, a parallel scale chart has been prepared to facilitate the selection of a spring. To use the chart, shown in Fig. 1, pass a line through the load, and corresponding elongation or depression required, which gives an intersection point on the requirement line "*R*", which point should be connected by a straight line to a point on the material line "*m*," depending upon the material used. The prolongation of this line will give an intersection on the dimensional line "*D*," and passing another line through this point, will give intersections enabling a selection of spring and wire diameters. An inspection of the point where the latter line cuts the "Spring Index" line will give the spring index, and if this is above the limit for the percentage elongation or depression specified on the chart or in the table, the spring will not be safe for the maximum load selected, and if below, it will be safe. To verify this, pass a line through the "Spring Index" and the "Percentage Elongation or Depression." The intersection of this line on the "Spring Criterion" line must, in order to give a safe condition, fall below the limit point designated for different conditions of service. Finally, to determine the number of coils for the spring, pass a line through the point on the scale corresponding to the diameter of the wire and through the percentage elongation or depression point, and the prolongation of this line will give the number of turns on the "*R*" line.

When the initial length "h_1" for a compression spring is required, this value should be substituted for "*H*" in the numerator only, which gives

$$\frac{h - h_1}{H} \times 100,$$

as the value to be set on the "Percentage Elongation or Depression $\left(\frac{h - H}{H} \times 100\right)$" line of the chart. However, it will not be necessary to do this if the following simple law is used to determine the value of the initial length "h_1" corresponding to the required intermediate pressure, namely, "that the depressions or elongations of a helical spring are directly proportional to the loads applied."

Sample Problem—Steel Compression Spring:

Given

$P_1 = 20$ ounces
$P = 30$ ounces
$H = 1$ inch
$h = 3$ inches
$D = \frac{1}{2}$ inch

To Find

$h_1 = x$ inches
$d = y$ inches
$N = z$

By above law $\frac{h - h_1}{h - H} = \frac{P_1}{P}$

Substituting $\frac{3 - x}{3 - 1} = \frac{20}{30}$

Or $x = h_1 = 1\frac{2}{3}$ inches

Now, $\frac{h - H}{H} \times 100 = \frac{3-1}{1} \times 100 = 200 =$ "Percentage Depression."

LIMITS FOR DIFFERENT CONDITIONS OF SERVICE

Material	Nature of Service	Value of "S" in Lb. per Sq.In.	Value of "G" in Lb. per Sq.In.	Value of $\frac{\pi S}{G}$ = Maximum Limit of $\frac{h-H}{HC^2}$	Minimum Limit for Spring Index When Per Cent Elongation Is Less than 150%
Steel music wire	Shock	60,000	12,000,000	0.016	10.0
	Frequency above 30 operations per min	80,000	12,000,000	0.021	8.5
	Frequency below 30 per min	100,000	12,000,000	0.026	7.5
Phosphor bronze	Shock	20,000	6,000,000	0.010	12.0
	Frequency above 30 per min	25,000	6,000,000	0.013	11.0
	Frequency below 30 per min	30,000	6,000,000	0.016	10.0

By using the chart we obtain the value of "d" equal to 0.037 in., and by inspection of the point of intersection on the spring index line we find that the spring index is considerably below the position of any "S," for steel which shows that the spring will safely carry the maximum load. This is confirmed by finding the value of the "Spring Criterion" on the chart, which in this case is considerably below the position of any "S" for steel, thus showing that the "Spring Criterion" is less than the "Material Index" for even severe service conditions. The number of turns "N" is found from the chart to be 26.

The case where the spring index can be taken equal to 10 before using the deflection formula, makes the latter reduce to a simpler form.

$$d = \sqrt{\frac{1000\,P}{2G} \times \frac{H}{h-H}} = \frac{1}{155}\sqrt{P \times \frac{H}{h-H}}$$

$$= 0.007\sqrt{P \times \frac{H}{h-H}} \qquad \text{For Steel}$$

It should be noted that if an initial load held in equilibrium by close winding be required for a tension spring, then the initial length h_1 becomes the solid length H, the latter existing only in an imaginary sense. In connection with this it is well to bear in mind the following law:

$$\frac{h_1 - H}{h - H} = \frac{P_1}{P}$$

The end loops for a tension spring are provided for by giving an approximate value to the length of the loops along the spring axis before using the deflection formula

$2L = 0.8D$ (where L = Length of one loop)

Finally, great care should be used in making or coiling a spring, particularly not to nick the wire with tools, and also not to allow the wire, if it be steel, to be exposed to corrosive influences from the moment the wire is drawn to the time for making it into the form of a spring. These points and others will be considered in greater detail in an article appearing at a later date.

Derivation of Formulas

Spring criterion must be larger than material index.

$$\frac{h-H}{H\,C^2} < \frac{\pi S}{G}$$

Work applied to spring $= \frac{1}{2}Pf$ (Maximum allowed)

Internal energy resulting or resilience $= \frac{1}{4}(S^2/G)aL$ (Total available useful work)

Where a = cross section $= \frac{\pi d^2}{4}$ and L = length of wire.

From the law of conservation of energy, ignoring friction losses, etc., and provided that the elastic limit is not exceeded; referring to Fig. 2:

$$\tfrac{1}{2}Pf = \tfrac{1}{4}(S^2/G)aL$$

Or,
$$P = \frac{\pi}{8} \times \frac{S^2 d^2\, Lf}{G}$$

$$L = N\pi D, \text{ approximately}$$

$$\therefore\ P = \frac{\pi^2\, S^2\, d^2\, D\, N\, f}{8\,G}$$

Now,
$$N = H \div d \text{ and } f = h - H$$

Hence,
$$P = \frac{\pi^2\, S^2\, d\, D\, H\, (h - H)}{8\,G}$$

But,
$$P = \frac{\pi}{8} \times S \times \frac{d^3}{D}$$

From Capacity Formula (2)

Therefore,
$$\frac{\pi}{8} \times \frac{S\,d^3}{D} = \pi^2\, S^2\, d\, D\, H(h - H)$$

Which gives,
$$\frac{h-H}{H} = \frac{\pi S}{G} \times \frac{D^2}{d^2}$$

Let, "C" equal the Spring Index $\frac{D}{d}$

And, "M" equal the Material Index $\frac{\pi S}{G}$

Then,
$$\frac{h-H}{H} = "M"C^2$$

or,
$$\frac{h-H}{H\,C^2} = "M" = \frac{\pi S}{G}$$

Which, for steel where S = 100,000 lb. per sq.in. and G = 12,000,000 lb. per sq.in., is, $\frac{h-H}{H\,C^2} = 0.026$

Hence $\frac{h-H}{H\,C^2}$, which should always be less than $\frac{\pi S}{G}$, may be called the spring criterion, and its maximum value depends entirely on the material used for making the spring.

Derivation of Capacity Formula

Capacity formula (2):

$$P_c = W = 2\pi \frac{Sd^3}{D}$$

Referring to Fig 3,

Resisting moment = Twisting moment

Twisting moment $= P \times \frac{D}{2}$

Resisting moment:

$\frac{S}{d/2}$ = Unit stress at unit distance from axis

$S\,\frac{Z}{d/2}$ = Unit stress at a distance Z from axis

$\delta_a\, S\,\frac{Z}{d/2}$ = Total stress on an elementary area δ_a

$\delta_a\, S\,\frac{Z^2}{d/2}$ = Moment of this stress with respect to center

$\Sigma\,\delta_a\, S\,\frac{Z^2}{d/2}$ = Internal resisting moment.

Since S and $d/2$ are constants, this resisting moment may be written $\left(\frac{S}{d/2}\right)\Sigma\delta_a Z^2$. But the quantity $\Sigma\delta_a Z^2$, being the sum of the products obtained by multiplying each element of area by the square of its distance from the axis, is the polar moment of inertia "J" of the cross section.

Hence, resisting moment $= \frac{S\,J}{d/2}$

"J" for circular section $= \frac{\pi d^4}{32}$

Substituting "J", resisting moment $= \frac{\pi\, Sd^3}{16}$

Hence, $P \times \frac{D}{2} = \frac{\pi\, Sd^3}{16}$

or, $P = \frac{\pi}{8}\frac{S\,d^3}{D}$, where P is in pounds

$P = 2\pi\,\frac{S\,d^3}{D}$ where P is in ounces (2)

DERIVATION OF DEFLECTION FORMULA

Deflection formula (1):

$$\frac{h-H}{H} = \frac{P}{2G} \times \frac{D^3}{d^3}$$

For meaning of symbols, refer to Fig. 4.

ϕ = Angle of twist in radians = ecb
ϵ = Deformation per unit length
E = Total deformation
F = Deflection per coil
f = Total deflection
S = Unit stress below elastic limit of shear
G = Shearing (or torsional) modulus of elasticity
J = Polar moment of inertia with respect to center
N = Number coils
P = Load in ounces

$$\text{By definition: } G = \frac{S}{\epsilon}$$

$$\epsilon = \frac{\phi\, d}{2} \times \frac{1}{\pi D} = \frac{\phi\, d}{2\pi D}$$

$$\text{And, } S = \frac{P\, D\, d}{4\, J} \quad \text{From capacity formula} \quad (2)$$

$$\therefore G = \frac{P\, D\, d\, 2\pi D}{4\, J\, \phi\, d} = \frac{\pi P D^2}{2\, J\, \phi}$$

$$\text{or, } \phi = \frac{\pi P d^2}{2JG}$$

Now: $\phi = \sin \phi$, approximately.

$$\text{And } \sin \phi = \frac{F}{D/2} = \frac{2F}{D}$$

$$\therefore \phi \quad \frac{2F}{D} = \frac{\pi P D^2}{2JG}$$

Since, $J = \frac{\pi d^4}{32}$,

$$\therefore F = \frac{\pi P D^3}{4JG} = \frac{32\pi P D^3}{4\pi G d^4} = \frac{8}{G} \times \frac{P D^3}{d^4}, \text{ for one coil.}$$

"F," "D," and "d" are in inches,
"P" in lb. and "G" in lb. per square inch,

The total deflection is equal to "f" $= \frac{8}{G} \times \frac{P D^3 N}{d^4}$

But, $f = h - H$, and $N = \frac{H}{d}$

$$h - H = \frac{8}{G} \times \frac{P D^3}{d^4} \times \frac{H}{d}$$

Or, $\frac{h-H}{H} = \frac{8}{G} \times \frac{P D^3}{d^4}$.

Where "P" is in ounces,

$$\frac{h-H}{H} = \frac{P}{2G} \times \frac{D^3}{d^3} = \frac{P}{2G} \times \left(\frac{D}{d^3}\right)^2 \times \frac{D}{d^3} \quad (1)$$

Dr. Hollis Calls Attention to Present Industrial Dangers

In an address at the joint meeting of the Metropolitan Section of the A. S. M. E. and the New York Section of the A. I. E. E. in New York City, March 25, Dr. Ira N. Hollis, president of Worcester Polytechnic Institute, emphasized the danger of undue exercise of power by a minority as a danger against which the Republic will have to guard.

"Unchecked power of minorities is a danger to any form of government," said Dr. Hollis. "We saw what it did to Germany when the junker rushed a whole people into this horrible war from which we are hoping some day to recover, and we saw what threatened last winter when the mining men went out. The actual interference of minorities over legislation and over elections is one of the very striking things in America. Those who hold the balance of power are virtually rulers of America. How far can this be permitted to continue without a breakdown? The only safety we have at the present time is in playing off one minority against another. Can that type of legislation be tolerated which exempts organized labor from the statutes while placing capital and all associations under injunction and legal prosecution? Positively not. It is not equality before the law, and it exerts the same destructive influence that has been found in the old countries where there is class privilege. Many of the claims by capital and many of the claims by the unions are of doubtful value, even to the men whom they both desire to benefit. If carried to their logical ends with labor agents in Washington they would reduce labor to the same dead level that we find in China; and given the capitalist the power we should ultimately find the same kind of slavery that prevailed under the czars.

There are few people in our country who desire anything but good to the workmen. There are few employers who would not want to pay adequately for their services, and most of our trouble springs from the power of minorities to dictate and to divert the attention of the people as a whole from the true definition of words and the ultimate evil resulting from the organization of one class against the other. One of the features of modern life is the power of a strike. Labor has gained through the unions in some respects, but it will require a generation to discover whether that gain has been really of benefit or not, whether it has been at all proportionate to the losses and poverty and misery introduced by throwing men out of work for some ultimate benefit. There is no doubt whatever that the industrial worker has a right to organize and that he has a right through representatives elected to represent him to better his condition in any way that is within the law; but the penalty for the wrong kind of organization is the dominance of men who really are more interested in obtaining power and in playing the game than they are in benefiting the man who is earning his living at the work bench.

There have been fluctuations in unemployment which have had a corresponding bearing on the wealth of the industrial workers. Today, for instance, there are four million men seeking employment; four million units charged, we might say, with electricity of a negative kind, ready to fly towards any center of attraction. They will form, unless conditions change, the nucleus of a Bolshevik government, because it is they who are dissatisfied and it is they who have made the first step towards complete loss of confidence in any kind of government. This is no gain in wealth; it is a loss. The curse of our modern controversy on the subject of capitalism or the capitalistic government springs out of a total misunderstanding of what opportunity means. When the present governing classes in Russia speak of the bourgeois with a certain amount of contempt they refer to the people whose families made Russia. Are we here drifting backwards toward that form of government or are we going ahead in developing opportunities and openings for men to rise out of the ranks? No statistics can answer that. It is impossible to answer the question satisfactorily, but we do know that when the time comes that a man's right to make a living shall be judged solely by his membership in an association, in a church, in a political party or otherwise, then our government is in danger."

Defiance Inverted-Spindle Drilling Machine

Spindle Housing Stationary—Work Carried on a Sliding Head—Workhead Provided with Screw Feed—Forced and Flow Feed Oiling in Inclosed Housings

By J. V. HUNTER
Western Editor, *American Machinist*

THE employment of the inverted-spindle drilling machine has become more common during late years, as new uses have been found for which its special merits render it adaptable. A common use is for deep-hole drilling, because of the chip clearance obtained when the drill is in an inverted position. Another is for that class of work that can be more conveniently held when standing upon the face that is to be drilled. A third class uses this type of drilling machine to avoid handling operations on the work. Thus, work that is being transferred from station to station while standing in an upright position, can be drilled on its lower face without having the workman expend effort in rolling it over and then again setting it upright.

It is said that experience gained in highly productive shops shows that it is cheaper to operate the drilling, tapping or boring spindle from the vertical position for the top surface of the work, drill the sides and ends with spindles in the horizontal position, and finally use inverted spindles for the bottom surface.

Construction of the Machine

The Defiance Machine Works, Defiance, Ohio, is building a line of inverted multiple-spindle drilling machines for the applications that have been mentioned. A belt-driven machine of this type is shown in Fig. 1. It has eleven spindles and was built for a special automotive job. The clearly apparent tendency of the designer was to keep as much of the mechanism as possible inclosed in adequate housings, which both protect the working parts from dirt and chips, and provide inclosures for the oil used in the lubricating system. Nearly all parts of the mechanism are oiled either by forced-feed, gravity-flow or by splash and spray. It is intended to have all internal working parts constantly running in a mist or spray of oil.

The base and column are a single casting of box construction, with broad finished bearing surfaces to which the unit parts of the mechanism are attached. The drive mechanisms for the speeds and feeds have been designed on the unit principle, and they are usually inclosed in compartments that have been cast integral with and on the outside of the main body casting. The column has finished square ways planed and scraped on its front face, upon which the work-holding fixture slides.

Method of Driving

A short drive has been planned from the pulley shaft to the spindle gear, in order to eliminate unnecessary lengths of shafts and bearings. Ball or roller bearings are used wherever the bearings are subjected to heavy service, in order to cut down the power losses. Although the feed drive can be controlled separately, the spindles can be stopped only by shifting the belt to the loose pulley.

When motor drive is used, the motor is mounted on a pedestal bolted to the rear of the column and base, Fig. 2. It drives through a silent chain inclosed in a grease case, and its starting mechanism is a push-button control switch located conveniently for the operator.

Spindle Drive Mechanism

The drill spindles, together with their driving mechanism, are housed in a separate casting bolted both to the base and to flanges on the front of the column. A single shaft carries the drive from the mechanism in the column to the speed-gear trains of the spindles. Since the machines are intended for single-purpose work, it has been possible to design the drive for each spindle so that its speed will be best suited to the diameter of the drill that it carries. The speed may vary considerably with the spindles of a single machine. Machines range from those with a large number of small spindles, such as shown in Fig. 1, to others with a few

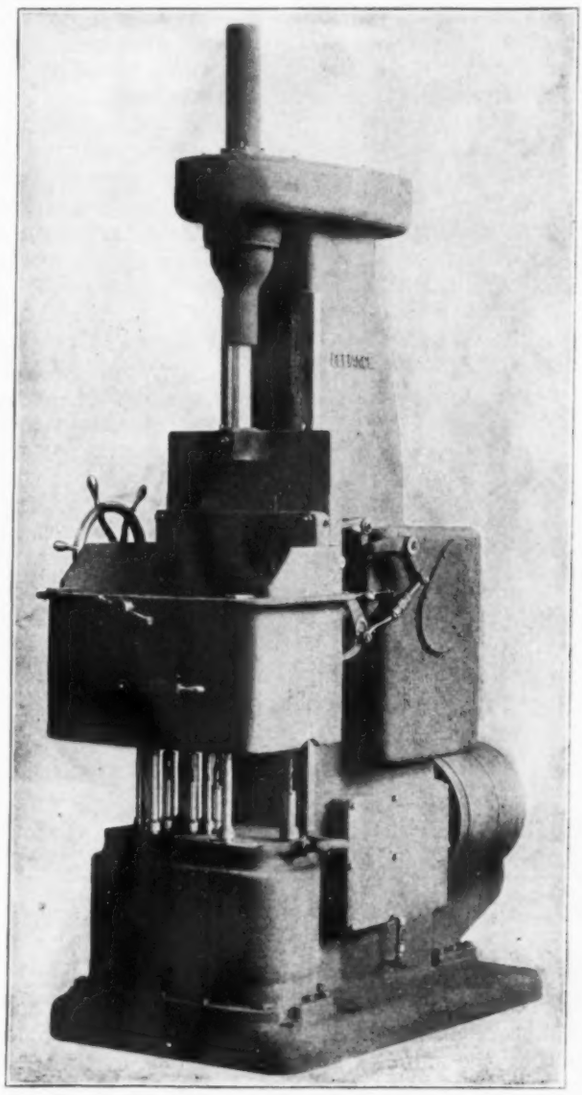


FIG. 1. DEFIANCE BELT-DRIVEN DRILLING MACHINE WITH 11 INVERTED SPINDLES

heavy spindles, as represented by the four-spindle machine shown in Fig. 2. The spindle drive gears are cut from steel and heat-treated.

Spindle Protection

The exclusion of dust and chips from the spindle bearings and drive mechanism is an important consideration in the design of inverted-spindle drilling machines. The plan adopted by this builder uses a sleeve with a conical base over each spindle, the base slipping over another sleeve that fits in the spindle opening in the top chip-plate. Felt washers are placed to exclude any

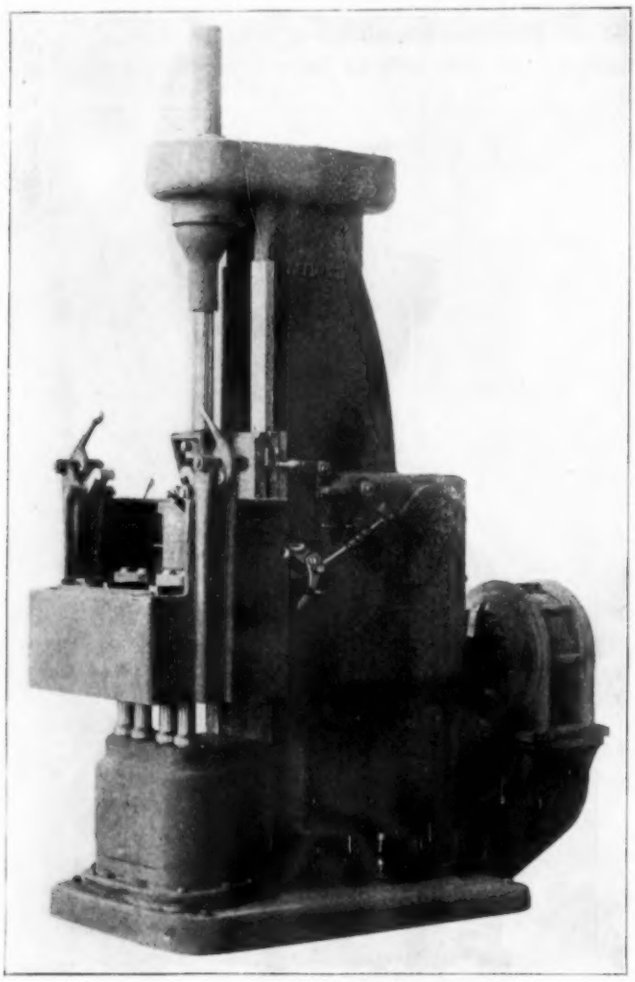


FIG. 2. MOTOR-DRIVEN MACHINE WITH FOUR SPINDLES FOR HEAVY DUTY

dust that might work up between the two sleeves. The chip-plate covers the top of the spindle housing and is but a mere shell that leaves a thin compartment surrounding the spindles and over the tops of their bearings. This compartment has an opening at each end, one of which is free and the other is connected by a pipe, shown in Fig. 1, with a vacuum exhaust line that can periodically be used to draw away any accumulations of dust in the compartment.

Workslide and Fixtures

In contra-distinction to the upright type of drilling machine made by the concern, the design of the inverted type provides for a stationary spindle housing, and the work is carried on a movable workhead that lowers it onto the drills. The workhead is mounted on a long saddle having square and flat-faced ways on the face of the column with adjustable gibs for taking up the wear. The outer face of the saddle is finished with a sliding bearing to permit adjustment of the work fixture when it is necessary to raise or lower it to suit different lengths of drills or depths of holes. A rack and pinion drive is provided for changing the position of the workhead on the saddle, and a screw clamp is used to fix it in place. The drill spindles are also equipped with collets that provide for individual adjustment, to care for the uneven grinding of the drills in a set.

Feed Drive Mechanism

The screw-feed rod reaches vertically from its housing in the top of the column to a bracket that extends forward from the casting of the workslide saddle. The feed screw is placed so that it will be located as nearly over the center of the area covered by the drill spindles as the nature of the work permits. It is claimed that this design occasions less side-thrust and twist on the saddle, and so makes possible greater accuracy in drilling. The feed-screw drive gears are located in a housing on the top of the column and are driven by a vertical shaft, inclosed in the column, from the main jackshaft in the base. The weight of the workhead and saddle is balanced by a counterweight that slides inside the column.

The range of feed may be set for automatic operation by means of the dogs that are adjustable on a slide on the side of the saddle (see Fig. 2). At the end of the down feed the upper dog engages a lever that throws off the feed and at the same time throws the feed-screw into reverse. This operates as a rapid return that quickly lifts the workhead until it has cleared the drills, and then another dog operates the lower lever on the side of the column and throws the feed-gear train into neutral. After the work has been replaced in the fixture, a single movement of the lever again throws the feed-gear train into operation and the cycle is repeated.

The Work Fixtures

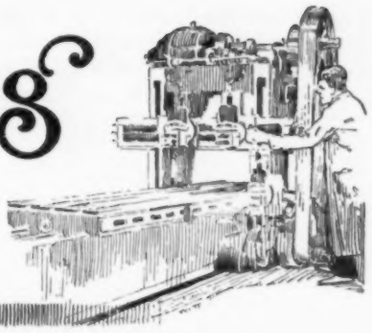
These machines have been designed as units of production lines or systems, and between the different machines the work is carried on roller conveyors that bring the pieces up even with the locating face of the fixture, onto which it may be easily slid. The work is usually locked in place by a few quick-acting levers, such as shown. The clamping of the piece is thus a matter of only a few seconds, as is fitting for a machine producing standard parts in large quantities.

Machines of this type have also been made for reaming, for boring and for tapping in multiple. When the machine is intended for use on a multiple tapping operation it is necessary to arrange the feed of the screw to be equal to the lead of the taps. For occasions when taps with different pitches are run in the same job, it is necessary to arrange their spindle speeds so that they all run with the same lead.

Both the lubricating oil and the coolant solution are carried in reservoirs that are cast integral with the base of the machine. Gear-driven wing pumps are used for circulating these fluids. The oil level in its reservoir is constantly shown by a glass indicator on the side of the base. The operator is thus able to see the oil being fed to the bearings, so that he may be certain that the machine is being properly and continuously lubricated, an important point on a machine operating continuously.

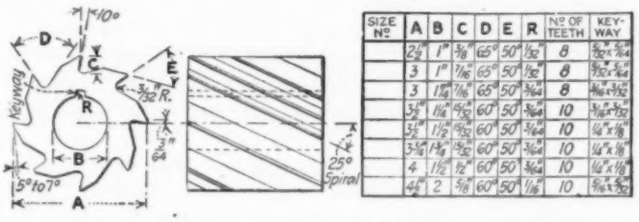
Metal Cutting Tools.

By A.L.DeLeeuw



VIII. Consideration of Milling Cutters Continued—Chip Breakers—Spiral Teeth—Action of Face and End Mills

THE previous chapters should not be considered a *theory* of milling cutters but merely a working hypothesis, just as the first chapter merely gave the writer's way of visualizing for himself what happens when a planer or a lathe cut is taken. The hypothesis



SIZE No.	A	B	C	D	E	R	No. OF TEETH	KEY-WAY
2½	1"	3/8"	65°	50°	1/32"		8	3/32"x3/64"
3	1"	1 1/16"	65°	50°	1/32"		8	3/32"x3/64"
3	1 1/16"	1 1/16"	65°	50°	3/64"		8	1/16"x3/32"
3½	1 1/4"	1 5/32"	60°	50°	3/64"		10	3/16"x3/32"
3½	1 1/2"	1 5/32"	60°	50°	3/64"		10	1/4"x1/8"
3 15/16	1 9/16"	1 5/32"	60°	50°	3/64"		10	1/4"x1/8"
4	1 1/2"	1/2"	60°	50°	3/64"		10	1/4"x1/8"
4½	2	5/8"	60°	50°	1/16"		10	5/16"x3/32"

FIG. 127. DIMENSIONS OF SLABBING CUTTERS

is of value to the writer because he has used it to explain to himself the action of milling cutters as he observed it, and, what is more, it has enabled him to predict what would happen under a given set of conditions, thus making it possible to steer clear of troubles and annoying limitations. In that sense the hypothesis as presented may be of value to others. Unfortunately, no fundamental observations have been made in regard to chip formation with the exception of the previously mentioned experiments by Professor Nicolson. A certain amount of special apparatus and a great deal of time and skill would be required to carry out experiments and collect data. Until such has been done we will have to satisfy ourselves with a hypothesis which has at least the merit of not disagreeing with known facts and phenomena.

We will now apply the ideas brought out in the last chapter to the construction of milling cutters of that class where the teeth are formed on the outside of a cylinder, or, to be more correct, on the outside of a body of revolution. (Let us say, for the reader not familiar with geometrical terms, that a body of revolution is a body which might be formed in a lathe.)

When the body on which the teeth are formed is a cylinder the cutter is called a plain or spiral cutter, according to whether the teeth are parallel with the axis or are wrapped spirally around the body. When the body is a cone or part of a cone, the cutter is called an angular cutter, and when the body is of some other shape, it is called a formed cutter.

Plain mills are used only for narrow work or where some peculiar condition does not permit the use of spiral teeth; in all other cases, spiral mills are used. Originally, plain as well as spiral mills were made with very fine teeth; they were, in fact, rotary files. Later on the teeth of cutters were spaced further apart and one can find in handbooks, treatises on milling, and various magazine articles a variety of rules and formulas to determine the proper number of teeth for a given milling cutter. The writer does not know on what these rules were based, nor is it of any importance, for a series of experiments and tests conducted by him in 1908, and after, showed conclusively that the tooth spacing then in use or recommended, was far from economical. This spacing was about ⅜ in., so that, for instance, a 3½-in. cutter would have from 28 to 32 teeth.

At the present time teeth of milling cutters are spaced according to requirements. The spacing of a cutter used for slabbing heavy steel work is entirely different from that of the little cutters used for the grooving of sewing machine needles. For the present we will confine ourselves to those cutters which are used in general machine-shop practice. Such cutters are now made almost exclusively with spiral teeth. It has been found that, all things considered, an angle of spiral with the axis at 25 deg. is most advantageous. Until a very few years ago an angle of 10 deg. was most commonly used.

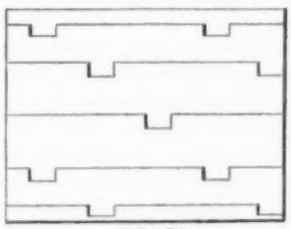


FIG. 128

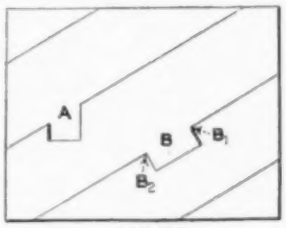


FIG. 129

FIG. 128. CHIP BREAKERS ON PLAIN MILLING CUTTER.
FIG. 129. CHIP BREAKERS ON SPIRAL CUTTER

It was found that a rake angle of 15 deg. was very suitable for milling steel, whereas an angle of about 8 deg. was more suitable for cast iron. It was also found that a clearance angle of 5 deg. would give the best results for slabbing steel, whereas an angle of 10 deg. was better adapted to cast iron. For general purposes a compromise has been made, so that such a cutter used for general purposes will have a spiral angle of 25 deg., a rake angle of 10 deg., and a clearance angle of 7 or 8 deg. The spacing recommended is about 1¼ to 1⅜ in. from tooth to tooth, but this distance must necessarily vary with the size of the cutter. Fig. 127 gives the dimensions for slabbing cutters from 2½ to 4½ in. in diameter.

Cutters of this style are often called high-power, or wide space, cutters. The name high-power cutters

For the author's forthcoming book. All rights reserved.

is rather misleading as it gives the impression that such cutters are not adapted to the lighter work. As a matter of fact they are adapted to light as well as heavy work under almost all conditions. They consume much less power for a given cut than the old style cutters with many teeth, no rake, and a small spiral angle. Tests made by the Cincinnati Milling Machine Co. and described in the "Treatise on Milling and Milling Machines," show that the mere reduction of the number of teeth in a cutter had the effect of increasing the amount of metal removed per net horsepower from 0.442 to 0.731 in. A comparison between a cutter with 25-deg. spiral, 10 teeth, and with 10-deg. rake, and another cutter with the same angle or spiral, the same number of teeth, but no rake, shows that the first cutter will remove 1.074 cu.in. per net horsepower, whereas the second cutter—the one without rake—removes only 0.724 in. Comparing the old style cutter with many teeth and no rake with the new style cutter with few teeth and the 10-deg. rake, we find that the modern cutter will remove 1.074 cu.in. against the old style cutter's 0.442 cu.in. of metal per net horsepower, or almost two and a half times as much.

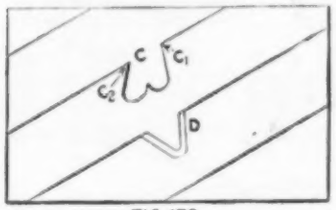


FIG. 130

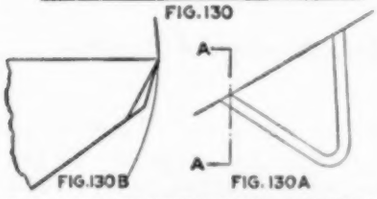


FIG. 130. OTHER FORMS OF CHIP BREAKERS

Putting this in another way, we notice that much less power is required for a given cut when we use the new style cutters, so that a weaker machine can be used for doing the same work; or, if the same machine is used, it will be strained to a less extent, less heat will be developed, and if the piece of work is of delicate section, the work will spring less. If, then, conditions will allow it, a wide spaced cutter should be used when a milling machine is hardly sufficiently powerful to do a given piece of work, and particularly when pressure and heat developed in the cut would have a tendency to distort the work. In other words the wide spaced cutter shows its usefulness in a more decided fashion when we use it for light work than for heavy.

In the previous articles we have discussed the reasons why rake and a small number of teeth should cause freer cutting action. We have also seen that in order to avoid shock it would be well to have a great many teeth and a large spiral angle. As a rule, the tendency to chatter is not very great with a 25-deg. angle and especially not if the teeth are cut with rake. There are a few cases, however, where the sections of the work to be cut are so thin that it would spring under the cut if an attempt were made to remove a large amount of metal per tooth; and so it will be found that there are individual cases where better results are obtained with the narrow-spaced than with the wide-spaced cutter. However, in all cases where the nature of the metal and the method of holding the work will permit, rake should still be used as well as a large spiral angle.

There are cases where rake is not desirable. If, for instance, we should have to cut lead, we would be compelled either to use a cutter without rake, or else with such a large amount of rake as to make the shape of the teeth resemble a sharp knife. The reason for this is that, after the cutter tooth has penetrated into the metal, there is a tendency to pull the cutter downward; in other words, it will gouge itself into the work if there is rake. This same would be true if the tooth were very sharp, like a knife, but in that case the power required to separate a chip from the body of metal would be so little that the pressure would not be sufficient to make the tooth penetrate further. For all practical purposes, it is well to use cutters without rake where we have to cut metal of the nature of lead. On the other hand where we have metal of the nature of cast iron, an impure heterogeneous mass composed of hard crystals and impurities and, consequently, with the tendency to act as an abrasive on the cutting edge, we must do all that is possible to strengthen the body of the tooth, so that a large amount of rake is not permissible, not because the large amount of rake would not make the cutting action easier, but because the sharp edge would soon be dulled by the action of the grit in the material.

It was customary to notch the teeth of slabbing cutters for the purpose of breaking up the chip. This was particularly useful with plain milling cutters, and almost to the same extent with milling cutters with a small spiral angle. Breaking up the chip would leave a little bit of metal uncut so that the next tooth would have to take an irregular amount of metal along its cutting edge, that is, it would have to remove a little bit more where the previous tooth had a chip breaker. The introduction of this little irregularity would quite effectively prevent chatter in many cases. However, it was found that the corners of the notches were the weak places in the milling cutter. They were the first points to dull and, of course, if a single point of the milling cutter has become dull, the rest must soon follow.

In Fig. 128 is shown a plain milling cutter with chip

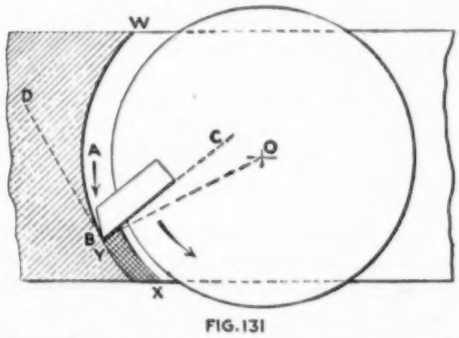


FIG. 131

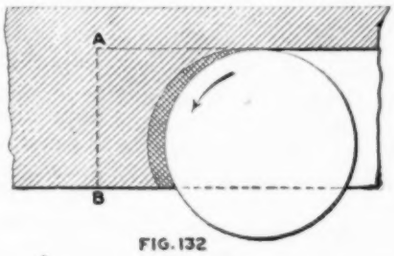


FIG. 132

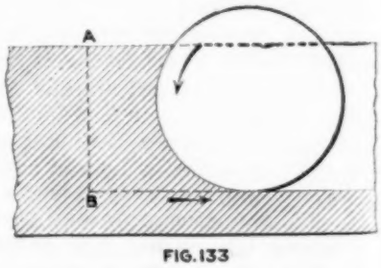


FIG. 133

FIG. 131. PLANER ACTION OF FACE MILL. FIG. 132. FACE MILL WIDER THAN CUT. FIG. 133. SAME AS FIG. 132 BUT WITH OPPOSITE FEED DIRECTION

breakers as they used to be made. It will readily be seen that the edges of the notch have no clearance, so that the corners must soon dull. Fig. 129 shows the same kind of chip breaker in a spiral cutter. In *A* they are shown cut in such a way as to make the axis of the chip breaker coincide with the direction of movement of the cutter. Again, there is no clearance at the two edges. At *B* a chip breaker is shown cut at right-angles to the edge of the tooth, showing that there is clearance at the point *B*, but negative clearance at the point *B*. In Fig. 130 a different kind of chip breaker is shown. The one shown at *C* consists of two notches intersecting

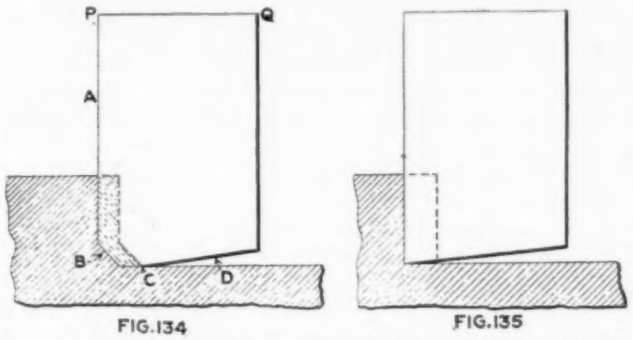


FIG. 134. CORRECT FORM OF FACE MILL TOOTH. FIG. 135. AN UNSATISFACTORY METHOD OF GRINDING TOOTH FORM

each other so as to provide clearance at both points C_1 and C_2. The chip breaker seen in Fig. 130A is of a different nature. This chip breaker is drawn to an enlarged scale in Fig. 130B, and shows that, due to its peculiar shape, all points in the arrow (which is the direction in which the cutting takes place) are in a lower plane; that is, closer to the center than the cutting point *A*. In other words, all points of this chip breaker have clearance. Not only was it found that the corners of chip breakers, when not properly constructed, would give out before the rest of the cutter, but it was

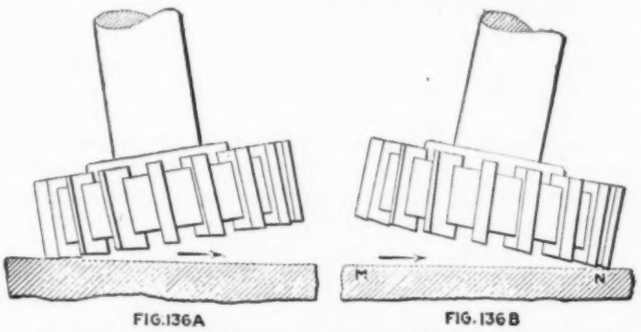


FIG. 136A. MILLING MACHINE SPINDLE LEANS LEFT. FIG. 136B. SPINDLE LEANS TO RIGHT

also found that the chip breaker, however well constructed, would reduce the life of the cutter. Wherever there is a chip breaker in tooth No. 1, there will be a little bit of metal left which was not removed by that tooth and which must be removed by the next tooth, so that a part of tooth No. 2 will have to take a cut twice as large as would otherwise be required. In practice it will be found that a portion of a tooth lying directly behind the chip breaker of the previous tooth will dull and break down before any other part of that tooth. Fortunately, it was also found that chip breakers are not at all required when the angle of 25 deg. is used. Though wide spaced cutters with a 25-deg. angle spiral are still made with chip breakers, this may be considered merely another case of human inertia. No perceptible difference can be found in the action of a properly constructed spiral cutter with or without chip breakers.

With the cutters so far considered, the finished surface of the work was produced by the cylindrical surface of the cutter sweeping over it. When the finished surface is produced by the sweeping over it of the end surface of the cutter, then the cutter capable of doing this work is called a face mill. In almost all cases the action of the face mill is entirely different from that of the spiral mill. Two cases must be considered here: (A) when the diameter of the cutter is greater than the width of the work to be milled, and therefore when the full width of the work is swept by the cutter; (B) when less than the full width of the work is swept by the cutter.

Fig. 131 illustrates the first case. The cutter is here again represented as having only one tooth. It has advanced a distance equal to the thickness of the shaded portion in the sketch, and now removes this section just as a planer tool would, except that this latter tool would move in a straight line instead of in a curve. Two sides of the blade are at work. A part of the bottom of the blade removes the thickness of the chip from the metal to be finished, and the vertical edge going through *B* separates the chip from that portion of the metal which will be removed later on.

In a roughing cut the depth of cut is probably several times the feed per tooth, so that such a milling cut corresponds to a planer cut with a relatively fine feed. In other words, the side of the tool does practically all of the work. Let us take, for instance, an 8-in. mill having 10 teeth, taking a cut $\frac{1}{4}$ in. deep and with a feed of 8 in. per minute. Let us suppose that the cutting speed is 60 ft. per minute, which corresponds to a spindle speed of about 30 r.p.m. This means that $30 \times 10 = 300$ teeth pass a given point per minute. In that time the cutter has advanced 8 in. so that the feed per tooth was 8/300 in. per tooth, or approximately 25/1000 in. Such a cut, then, would correspond to a planer cut of a depth of $\frac{1}{4}$ in. and a feed of less than $\frac{1}{32}$ in. This shows that less than $\frac{1}{32}$ in. of the bottom of the tooth comes into action, whereas $\frac{1}{4}$ in. of the side of the tooth is at work. It is often erroneously thought that the bottom of a face mill is doing the work, and for that reason many people grind the bottom of the teeth of their face mills to a perfect plain surface at right angles to the axis. As a result, they get the same effect as if they were taking a planer cut of only $\frac{1}{32}$ in. feed with a tool 1 in. in width, allowing the entire inch of width to drag over the work. We would never think of doing such things while planing, yet it is the most common way of taking cuts with a face mill. The shape of the tooth should correspond to the shape of a planer tool used under such conditions, and this is the round-nosed tool. However, to grind a large number of round-nosed tools all held in one body to exactly the same shape, and have them all stand out to the same diameter and to the same depth would be exceedingly difficult.

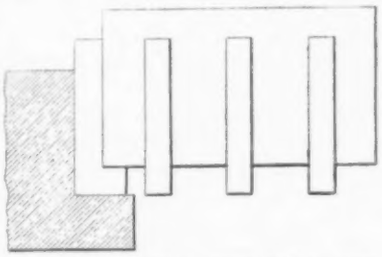


FIG. 137. TYPICAL END MILL CUT

For this reason, we give the face mill tooth a somewhat different form: we compromise, and give it the form as shown in Fig. 134. The side *A* is the cutting side. The corner *B* is beveled at an angle of 45 deg.,

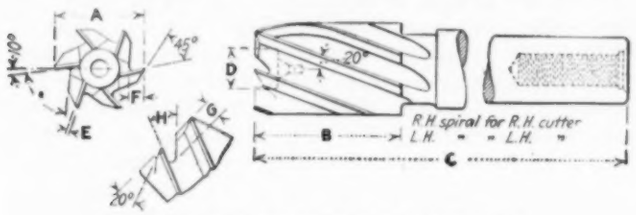


FIG. 138. COMMON TYPE OF END MILL

to give the tooth a shape somewhat approaching that of a round-nosed tool. The land *C*, which is in the plane of the finished work, is kept short and should not exceed $\frac{1}{16}$ in. The portion *D* is ground away at a slight angle, generally 3 to 5 deg. The width of the cutter *PQ* must be kept fairly large to give it sufficient strength and sufficient bearing in the body if it is an inserted blade, or to give it enough chip clearance if it is a solid face mill. But for cutting purposes the portion *D* does not come into play.

Realizing that trouble is experienced if the full width of the tooth rests on the work, many shops grind the teeth of their face mills as shown in Fig. 135. In this case, the bottom of the tooth is not ground to a right angle with the axis, but is relieved at a slight angle, often not more than one degree. This manner of grinding is not satisfactory. In the first place, there is a sharp corner which reduces the life of the cutter, as has been mentioned before. In the second place, each succeeding tooth striking over the work leaves a little groove of triangular section, and produces an unsightly, scratched appearance, as there is no flat—or land—to remove this scratched-up surface.

It was said that part *D* of the cutter blade is not in action. This would be true if the spindle of the milling machine were at perfect right-angles to the work. However, such is never the case. Take for example a vertical milling machine, and it will be found that the spindle leans either one way or the other. In Fig. 136A, the milling machine spindle leans to the left, and the work feeds to the right, as shown by the arrow. In this case, the portion *D* of the blade does not act. If, however, the spindle were leaning to the right and the work were feeding to the right, then a portion of the work *M* which has passed the leading tooth, would gradually come to the position *N* where it would meet a tooth standing at a somewhat lower level, and the portion *D* of the blade would remove a slight amount of metal. If the entire bottom of the blade were straight, then this tooth would have to take a slight finishing cut the entire width of the blade which would probably cause chatter. The bevel given to this portion *D* prevents this condition and will finish up the work smoothly and without causing chatter.

In Fig. 132 a condition is shown where the cutter does not sweep over the entire width of the work. In this case, we have a condition approaching the action of a plain milling cutter, because the initial depth of the cut is zero. There would be the same tendency for the cutter to crowd away from the work as in a plain milling cutter, only in this case the conditions are very much more favorable to the cutter. With a plain milling cutter—or a spiral cutter for that matter, we might want to take a cut 4 in. wide, of a depth of $\frac{1}{8}$ in., and the cutter would have to penetrate the work for this entire width of 4 in.; whereas the tendency to hold the cutter down is caused only by the fact that after the cutter has once penetrated there is a layer of metal above the blade which requires, to a certain extent, vertical pressure to shear it off. This layer, however, is thin, so that the resistance against penetration is very great and the tendency to hold the cutter down is relatively small. When we have a condition as represented in Fig. 132, where we will suppose that we are also removing $\frac{1}{8}$ in. of metal, we have the condition of a plain milling cutter taking a cut $\frac{1}{8}$ in. wide, and of a depth equal to the distance *AB*, which may be 4 in. or even more. Recapitulating, in one case, we had a cut 4 in. wide and $\frac{1}{8}$ in. deep; in the other case a cut 4 in.

A	B	C	D	E	F	G	H	J	№ OF TEETH	№ OF TAPER
1"	11/16"	2 5/32"	3/32"	1/64"	3/64"	3/64"	20°	90°	4	4
3/8"	3/4"	2 7/32"	1/8"	1/64"	1/16"	1/16"	20°	90°	4	4
1/2"	1"	3 7/32"	3/16"	1/32"	3/32"	3/32"	20°	90°	4	5
3/4"	1 5/8"	5 3/32"	5/16"	1/32"	5/32"	1/8"	30°	90°	4	7
1"	1 7/8"	5 15/32"	7/16"	1/32"	3/16"	3/16"	30°	90°	4	7
1 1/2"	2 1/4"	7 1/8"	5/8"	1/32"	1/4"	1/4"	25°	75°	6	9
2"	2 3/4"	9 9/32"	15/16"	1/32"	9/32"	1/4"	30°	70°	8	10

FIG. 139. DIMENSIONS OF END MILLS

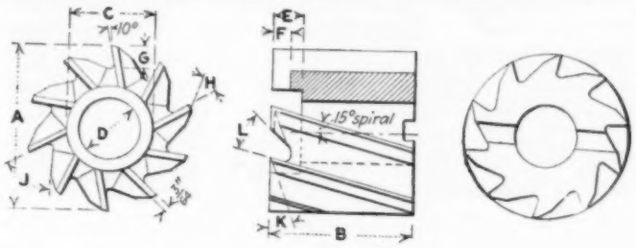
deep and $\frac{1}{8}$ in. wide so that the effects of the comma-shaped chip are almost negligible in the face mill. However, there are cases where the depth of cut is quite great, and the width much less than in the case represented in Fig. 132. If, for instance, we should have to take a cut as shown in Fig. 137, we should not overlook the fact that we will have conditions resembling the plain milling cutter much more than the face mill.

Finally, there is the case shown in Fig. 133. As a rule, such conditions can be avoided, but often it may be found desirable to take a cut such as illustrated. In Fig. 132 the cutter entered the side of the work which was left standing, whereas in Fig. 133 it enters the side of the work which has to be removed. If the distance *AB* were very small, the cutter would have a tendency to drag the work in the direction of the arrow; we would take up the lost motion in lead screws, etc., the cutter would dig in, and might cause a wreck. Where the depth of the cut is considerable—such, for instance, as shown in Fig. 133—there is still the same tendency, but the resistance offered by the metal from *A* to *B* is so great that such a cut can be taken without any danger of pulling the work into the cutter. The writer remembers a case where an extremely heavy cut had to be taken, the section of metal to be removed being about 4 in. wide, about 3½ in. high, and, being of irregular shape, of a cross-section about 10 in. square. The instructions were to do this with one cut, but the shop men, fearing that the cutter might break under this extremely heavy duty, tried to do it in two cuts. As a result several cutters were broken and always on the second cut. When the cut was taken in one single operation no cutters were broken. The reason was that the distance *AB* had become small on the second operation so that the cutter would pull the work in with resulting disaster. When the entire amount of metal was removed in one cut there was enough distance *AB* to prevent the cutter from pulling the work in.

Face mills, even more than plain mills or spiral mills, are made in innumerable sizes, from $\frac{1}{8}$ in. up to 10 ft.

The smaller sizes are commonly called end mills. There is no distinct line of demarcation where the end mill stops and the face mill begins. Speaking broadly, end mills are used more for cuts such as represented in Fig. 137; face mills for ones like those in Fig. 131. When a mill of the face mill type is made in one with the shank, it is always called an end mill. When it is keyed or screwed or bolted to the nose of the spindle, it is always called a face mill. When the mill itself is made separate from the shank, and either keyed or screwed or shrunk onto it, it is sometimes called the one and sometimes the other. Fig. 138 is a typical end mill. As the action of an end mill in a large number of cases is the same as that of a spiral mill, the teeth are generally mounted spirally around the body. Sometimes they are parallel to the axis. Again, they are sometimes made with, and sometimes without, rake. They may be made right and left hand, that is, so that they will cut when the spindle is turning in a right-hand or in a left-hand direction, and furthermore the spiral may have a right-hand or left-hand slope, and that regardless of whether the mill is for right-or left-hand rotation. Whether a right- or left-hand cutter should be used depends entirely on the direction of the spindle. In a duplex machine both right- and left-hand cutters would be used.

Whether the cutter should be made with or without rake depends largely on the nature of the cut to be taken. As the difficulty of sharpening the cutter is somewhat greater with rake, and end mill without rake



A	B	C	D	E	F	G	H	J	K	L	No. OF TEETH
1¾"	1¼"	27/32"	½"	5/16"	7/32"	7/32"	45°	70°	20°	30°	8
2"	1¾"	1⅛"	¾"	⅜"	1/32"	¼"	45°	60°	20°	30°	10
2½"	2¼"	1⅜"	1"	½"	9/32"	5/16"	50°	60°	20°	35°	10
3"	2⅜"	1½"	1"	⅝"	11/32"	⅜"	50°	60°	15°	35°	10
4"	2½"	2¼"	1"	¾"	7/16"	½"	50°	60°	15°	35°	10
5"	2⅝"	3"	1"	⅞"	½"	9/16"	50°	60°	15°	35°	12
6"	2⅝"	3¼"	1"	⅞"	9/16"	5/8"	50°	60°	15°	35°	12

FIG. 140. DIMENSIONS OF SHELL END MILLS

may be preferable, provided the cuts are light and especially when materials other than steel are to be worked. It is actually better to use end mills without rake for brass, hard aluminum alloys, etc.

These mills are shown with tapped hole for draw-in bolt, though quite often cutters of this description are made with a tang. The writer would like to discourage the use of a tang for end mills. The drive of the end mill should be accomplished by the intimate contact between the shank of the mill and the taper of the spindle. When this intimate contact is destroyed, the mill can no longer produce good work, regardless of whether it is driven or not. The tang would keep on driving the mill, and the operator would not notice that the fit between mill and spindle had been destroyed. With a draw-in bolt intimate contact is assured and if this contact is not sufficient to drive the mill against a certain cut, the only thing to do is to use a mill with heavier shank or drive in some other way.

When the end mill is used over a very small portion of its length only, spiral teeth are of no benefit. But where it is used as an ordinary spiral mill, the spiral is of as much importance for smooth action as it is for spiral mills mounted on an arbor. On mills of this latter class a spiral angle of 25 deg. was recommended. If this angle were used on end mills a very sharp and rather weak point would be formed where the spiral teeth join the end teeth, so that an angle of not more than 20 deg. is recommended for end mills. Fig. 139 shows a tabulation of the main dimensions of some sizes of end mills.

There has been quite some controversy as to whether a right-hand or left-hand spiral should be used on a right-hand end mill. Experience has taught the writer the following: where a considerable portion of the length of the end mill is used for a cut, and where the material is steel or any other material forming strong chips, the spiral should be the same hand as the cutting direction of the mill; that is, a right-hand end mill should have a right-hand spiral, whereas a left-hand end mill should have a left-hand spiral. The right-hand spiral on a right-hand end mill has the tendency to pull the chips away from the work. If the spiral were the other hand, the chips would be crowded toward the work and would have to be chewed up by the mill in order to get out of the way. The only reason given for making a right-hand mill with a left-hand spiral is that the same cause which would pull the chips away from the work would also be the cause of pulling the mill out of the spindle. This argument is of very little strength. The pull is not sufficient to cause any trouble when the shank of the mill has a fair fit in the spindle. Besides, if the mill is of any considerable size it should be held in the spindle by a pull rod or draw-in bolt.

When end mills are used for profiling on a hand-operated profiling machine, it is generally desirable to use them either without spiral or with the spiral in the opposite direction from that recommended for ordinary practice. The spiral would act against a tendency of the cutter to cut too deep or below size.

The end teeth of an end mill should be treated just like the ends of the blades of a large face mill; that is, the corners should preferably be beveled, a very small land at right angles to the axis should be provided and the rest of the teeth should be relieved. It used to be customary to extend the teeth of an end mill to a point

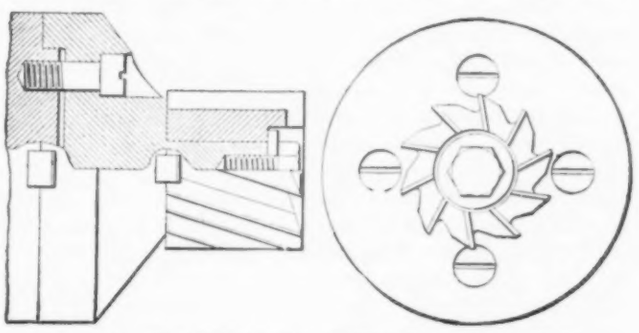


FIG. 141. ADAPTER FOR DRIVING LARGE SHELL END MILL

as close to the center as it was possible to bring them, apparently with the idea that these long teeth would add to the cutting quality or the life of the cutter. As a matter of fact, all they did was simply make the grind-

ing so much more difficult. The present end mills are counterbored, and the counterbore is made as large and as deep as one dares to go without danger of weakening the remainder of the teeth too much. A deep counterbore makes it possible to grind the cutter many more times. It may be said that the length of life of an end mill is proportional to the depth of the counterbore. To a certain extent the counterbore also assists in keeping the cutter cool, for with a sufficient supply of coolant the counterbore will be filled and the body of the cutter will be cooled from the inside as well as the outside.

When end mills get to be beyond a certain diameter, it is no longer profitable to make them solid, though lately this matter has not been of as much importance as it used to be. Until a few years ago all end mills were made out of a single piece of steel, which was of the diameter of the largest part of the end mill. The mill part itself might be only 2 in. long, but the shank might be 7 or 8 in. For an end mill of 4 in. diameter, a piece of high-speed steel 4 in. or more in diameter and 9 or 10 in. long would be required, whereas this high-grade metal was only required for 2 in. of its length. Nowadays, the shanks are often made of carbon steel and welded to the high-speed cutter. There is, of course, always the possibility that the weld is not perfect, so that, to a certain extent, welded cutters are viewed with suspicion. The writer's experience has been that welded mills can be made quite successfully and without any more danger or breakage than solid cutters. In fact, it is possible to select for the shank a material which has greater strength than the high-speed steel itself. It is, however, necessary to do the welding in the proper way, and to allow enough extra metal on both shank and cutter for a flash. The amount of extra material to be allowed for a weld should be equal to one-fourth of the diameter at the weld for each of the two pieces. If, for instance, the diameter of the cutter at the weld is to be 1½ in., then an extra length of ¾ in. should be allowed for the cutter and also for the shank. Another point of importance in making welded cutters is to make the weld at a point where both pieces are of the same diameter. Of equal importance is the necessity of employing a butt-welding machine of sufficient capacity.

Fig. 140 shows a tabulation of the dimensions of some sizes of shell end mills. A shell end mill is in some way assembled with its shank. The methods of assembling vary considerably. For ordinary work, and even quite heavy work, the shrinking method can be very successfully used. By this method the stub end of the shank which is to enter the shell is made from one-half to three-fourths of a thousandth larger than the bore of the shell. The shell is provided with a keyway and a key is laid in the stub end of the shank. Placing the shell in hot water expands the bore sufficiently to allow the shank to be driven in with light taps. To remove the shell it is again placed in hot water, which will expand the bore sufficiently for the shank to be driven out without much trouble. Care should be taken not to make the amount of shrink too great for a shrink naturally sets up heavy strains in the shell and might cause it to break, particularly across the corner of the keyway. This danger does not need to be taken too seriously if the proper dimensions for shank and bore are selected.

Though the shrink drive gives quite good results for light and medium cuts, it is not quite sufficiently positive for heavier cuts. When the shrink is no longer sufficient to do all of the driving, the key which was laid in the stub end of the shank must do part and maybe all of the driving and has a tendency to split the cutter. Breakage of shell end mills by splitting at the keyway is quite a common occurrence when this style of drive is used. For this reason it is preferable to do the driving by means of a cross-key at the rear surface of the mill. This method is shown in Fig. 140.

Though this cross-key assures a good drive between the shank and the end mill, yet it does not solve the problem of driving the shank positively. It may be quite easy to give a powerful drive to a 2-in. end mill by means of a No. 12 B. & S. taper, but such a drive would not be sufficient for a 6 in. shell end mill when it is used to its full cutting capacity. Fig. 141 shows how this difficulty may be overcome by making an adapter which is driven from the spindle by means of a cross-key, which in its turn drives the mill by means of a cross-key, and which is centered on the spindle nose.

Ordering Materials by the Month

BY PETER F. O'SHEA

The cost of keeping an inventory of materials on hand is so great, especially of late, that if even a small part of this material is stocked longer than is absolutely necessary, waste is involved that should be eliminated. The favorite method of maintaining stock is by maximum and minimum method, so that when the stock sinks to a certain dangerously low point it is at once renewed; but the supply is never raised above a certain maximum. Between these two limits, however, there is considerable margin, which varies from month to month, so that at certain periods of the year or during a dull season the stock will last a long time.

The Ritter Dental Manufacturing Co. finds that it saves a great deal of this time and speeds up its turnover of raw materials by keeping stock on the basis of one-month's parts. Each month the manufacturing requirements for the next month are determined, and a sheet is issued to each department showing the corresponding quantity of each part that is to be made. A similar sheet goes to the raw-material stores' clerk. He looks up his inventory cards and sees whether or not the required quantity is on hand. This quantity in a given month may be less than the former minimum. If a barely sufficient supply is on hand no new order is placed.

This method came in especially handy when the recent slump struck the market and caused a decrease in output. It is a more flexible method than the establishment of a standard maximum and minimum. Of course, the stores' clerk or the purchasing department should adjust its maximum and minimum to suit trade conditions, but this frequently is a very complicated matter requiring skill and judgment, and, therefore, is likely to be overlooked in the stress of routine work. Moreover, a card upon which several changes of maximum and minimum have been made does not remain very neat.

A Man's Greatest Mistake

BY F. C. BRYANT

The sketch appearing on page 272 of the *American Machinist* has, I believe, a wrong caption.

The caption should read: "The Man Who Is Making His Greatest Mistake." For it is the writer's firm belief that the man who ventures nothing is making a greater mistake than he who tries much and fails.

Methods of Motor Assembly

Assembling the Essex Pistons and Connecting Rods—Testing Squareness of Pistons—The Testing Room and Motor Stands

SPECIAL CORRESPONDENCE

THE proper assembling of motors has more to do with their satisfactory performance than many seem to realize. In some cases good workmanship on the motor parts is neutralized by lack of care in assembling and the completed motor may be no more satisfactory than one which is carefully assembled from parts not so accurate.

Without going into extreme details, the following illustrations show the high spots in the assembly of the Essex motor. As the way in which a motor is assembled has much to do with its running qualities it is interesting to note the care taken in the various operations shown.

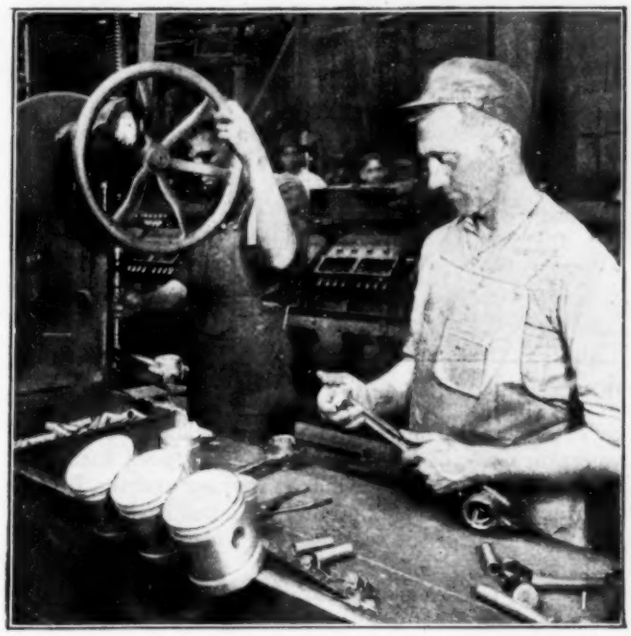


FIG 1. ASSEMBLING PISTONS AND CONNECTING RODS

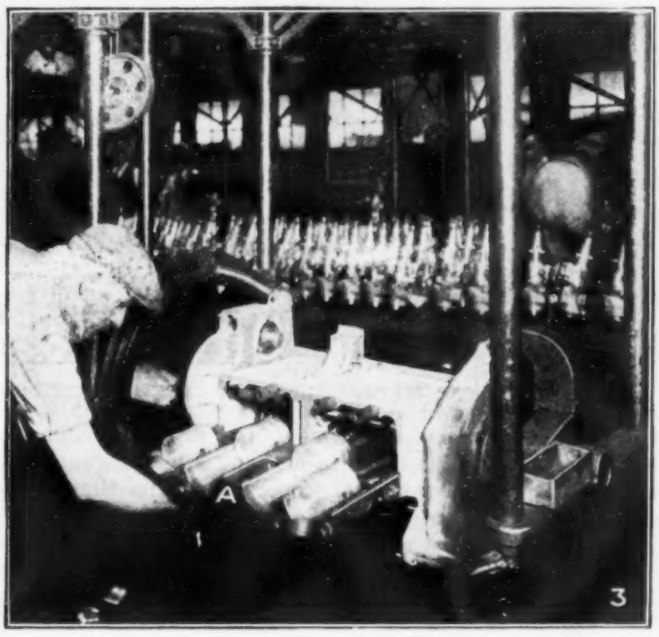


FIG. 3. TESTING SQUARENESS OF PISTONS

Fig. 1 shows the piston-pin bushings being pressed into the connecting rods and the rods being assembled to the pistons by means of the floating piston pins shown. Three assembled pistons and rods are shown against the back of the bench in the foreground, the piston pins being tried in the rod bushings before being assembled, as can be seen.

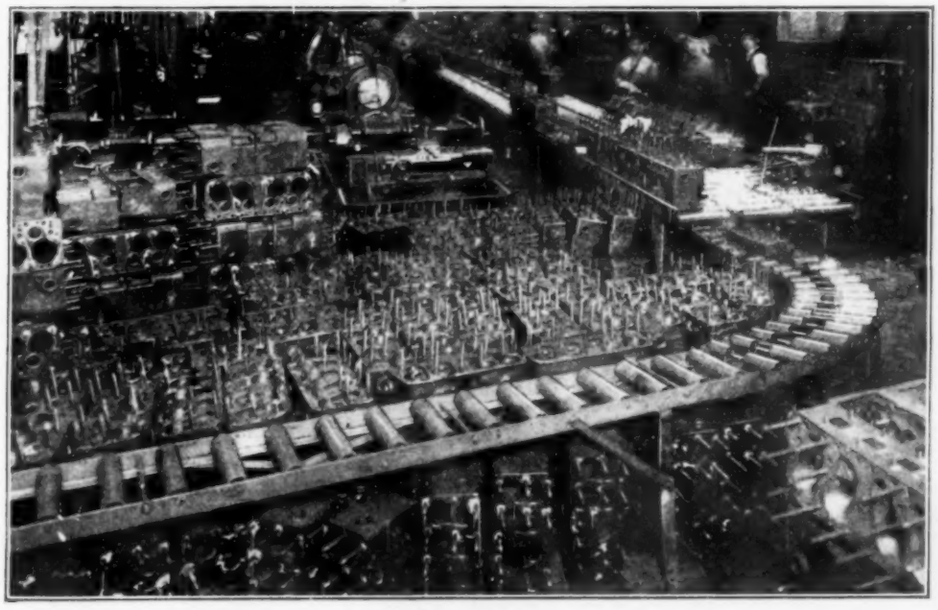


FIG. 2. STUDDING CYLINDERS FOR ASSEMBLY

The cylinders are studded before going to the assembling department, a lot being shown in Fig. 2. They are moved to the assembly department on the roller conveyors shown.

Before fastening the cylinder block to the engine base or crankcase the crankshaft and camshaft are assembled in the revolving frame shown in Fig. 3. Here a testing block A, which is in the form of half a cylinder block, is bolted into place, and the connecting rods and pistons tested for squareness at different points of the stroke before the cylinder block is put into place. It will be noted that the cylinder

FIG. 4. TRAVELING ASSEMBLING STANDS USED

block studs are protected by short lengths of rubber hose which keep the threads from injury and also safeguard the knuckles and elbows of the operators. The timing gear *B* is hung where it can be conveniently reached when the assembler is ready for it.

After being assured that the piston movements with relation to the crankshaft are correct the cylinder blocks are put in place, the line proceeding as in Fig. 4, by means of the carriers which are supported in the overhead track at *A*, with side thrust rollers as at *B*. Moving along this track, the department shown in Fig. 5 is reached. Here the oil pans or lower halves of crankcases are put on, the timing gear covers put in place and the motors are then ready for the block test.

The motors are handled by the overhead crane shown in both Figs. 5 and 6, the latter showing the kind of hook or tongs used in lifting the motors. The motors can be quickly handled and placed in the proper stands without delay by this device.

Fig. 6 gives an idea of the size of the testing room and also shows the convenient arrangement of the testing stands. The motor is clamped at four points, as when in the car. The inlet and exhaust connections are readily made by means of the quick acting handles *A* and *B*. The thermometers *C* and *D* show the temperature of the cooling water as it goes into and leaves the motor. Drop pans are provided and the funnel *E* carries off any surplus oil and makes it easily possible to keep the floor of the testing room clean and free from oil and grease.

There are electrical connections on every stand, both for testing the starter and supplying current for ignition. A little examination of the floor construction will show that the stands are located over a sort of subway which carries all piping and wiring and which is readily accessible by lifting one of the floor plates as *F*.

FIG. 5. ASSEMBLING OIL PAN AND TIMING GEAR COVER

The Oakland Motor

One of the reasons that assembling methods differ widely in various motor shops is on account of the difference in production. As the production increases it becomes necessary to introduce new methods which allow a steady flow of material from one end of the department to the other, from the time the material enters the department until the completed motor is on the way to the test stand. The view in Fig. 7 shows the cylinder blocks starting on their way from the final machining operation to the assembling department. Plain slides are used in this case. One of the first assembling operations is to insert the studs which hold the main

bearing caps in place. A crankshaft balancing machine is shown at *A*. The connecting rods and pistons are fed into the lines as the motor blocks pass toward the further end of the room.

In Fig. 8 we have the beginning of the "burning in" of the crankshaft bearings. The cylinder block is clamped in position at *A*, the handwheel *B* making the operation very easy. The transmission at *C* is driven by an electric motor and allows various speeds to be easily obtained. It will be noted that the cylinder block has simply been switched off the main line for "burning in," and after this has been accomplished it swings back into the line and goes on toward final assemblage.

FIG. 6. THE MOTOR TESTING ROOM

Fig. 9 shows one of the motors with the crankshaft and flywheel in place and the six pistons with their connecting rods in the cylinders but not in place on the shaft.

After the connecting rods are put in position the cylinder block is again switched off the main line and goes to another motor as shown in Fig. 10 to have the connecting rod bearings "burned in," as with the main bearings. Fig. 10 also shows very clearly the method of clamping and the ease with which it can be done. The slide *A* is provided with the handle *B* so as to allow it to be easily moved into clamping position. The clamping screw *C* is provided with a good-sized handwheel and handle which allows rapid clamping.

After the final "burning in," the oil pan or lower crankcase is put in position, the motor turned over and mounted in the cradle shown at *A*, Fig. 11. This cradle has casters which run in the channel irons shown. Mounted on the cradle the motor is moved along for

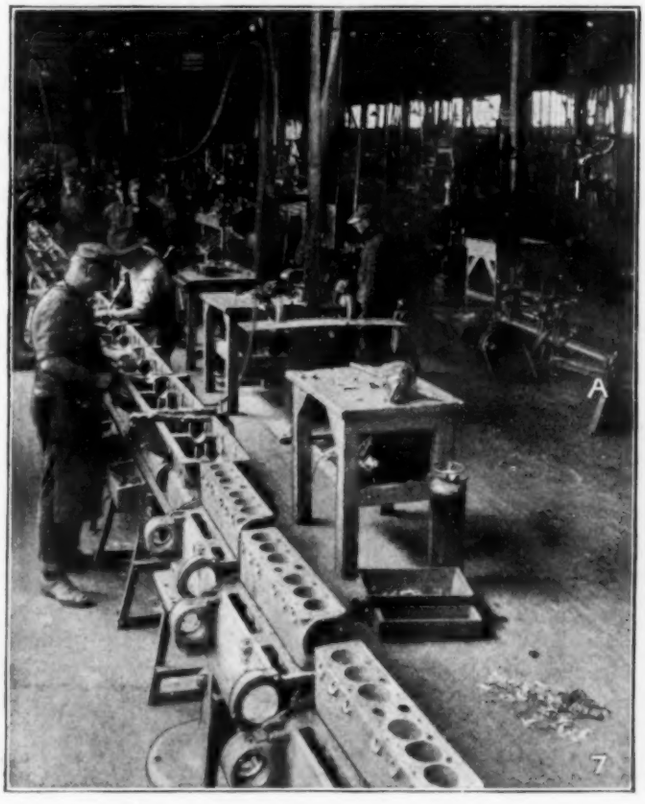


FIG. 7. STUDDING FOR BEARING CAPS

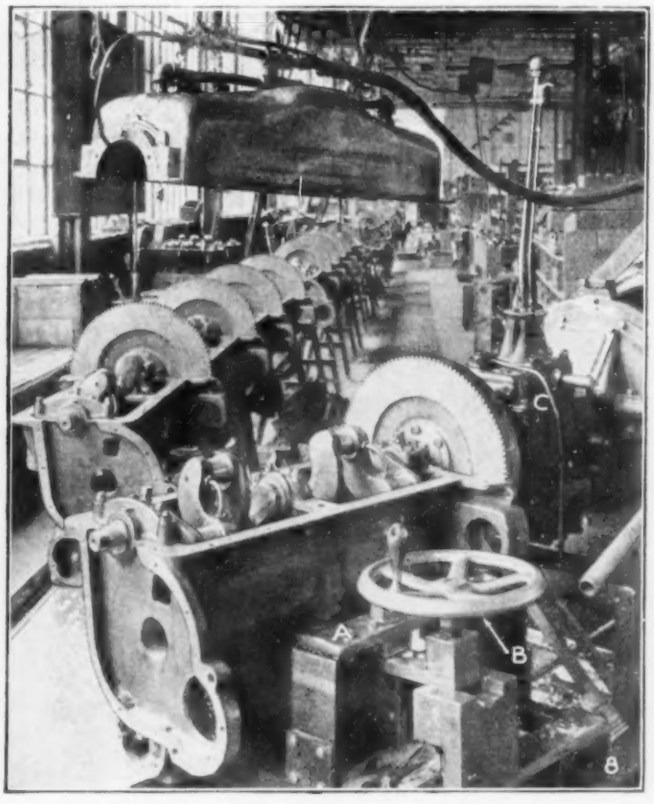


FIG. 8. "BURNING IN" MAIN BEARINGS

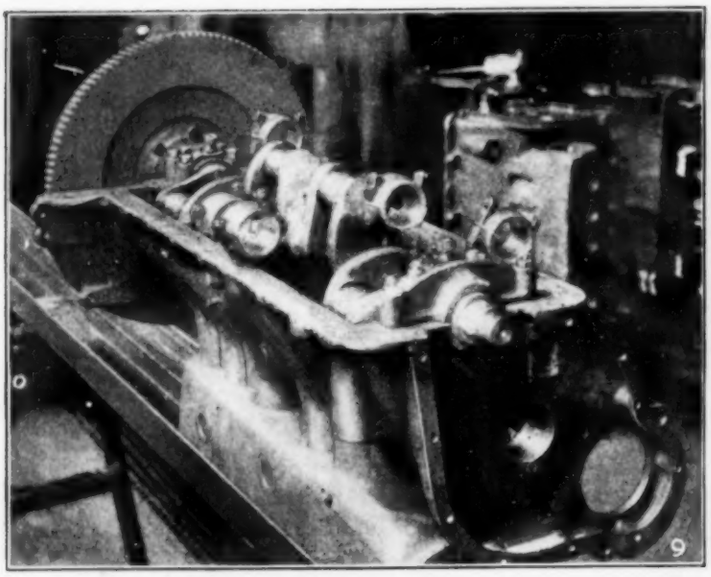


FIG. 9. PUTTING IN PISTONS AND RODS

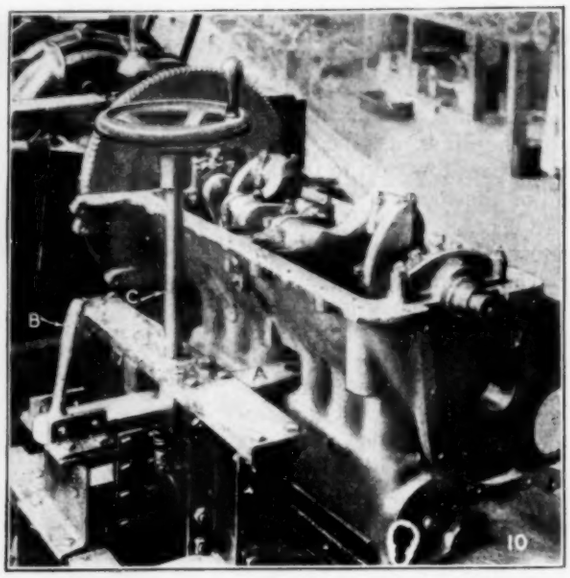


FIG. 10. "BURNING IN" ROD BEARINGS

further assembling, including the putting on of cylinder heads, valves, starter and generator. At the end of this runway is a small overhead crane which carries the motors to the testing stand.

Different devices are used for running in crankshafts and connecting rods. Fig. 12 shows the machine used in Plant No. 3 of the Studebaker factory in Detroit. The rods are mounted on the crankshaft, which is placed in the machine and held by the four bearing caps shown. The crankshaft is driven from a belted pulley at the right, the upper end of the connecting rods being guided by the plates *A* and *B*. The plate *B* swings down over the end of the rod, confining the ends of the piston pins in the ways shown and guiding the upper end of the rods during the running-in operation. The cover *C* is let down over the rods to keep the oil from being thrown over the shop.

Part of the Ford Assembly

A busy portion of the Ford motor assembly department is shown in Fig. 13. This view also gives something of an idea as to the method of using conveyors of various kinds and the way in which the motors are handled generally. The motors are brought in from the left along the cross runways shown, being mounted on small special trucks, as can be seen on close examination. The overhead conveyors at each side of the picture, *A* and *B*, keep the assemblers supplied with the different parts which are to go in place. The conveyor at *A* is handling transmission covers, while the conveyor on the right handles inlet and exhaust manifolds as at *C*.

Nuts and bolts are tightened by a modified electrically driven drill as at *D* and *E*. These portable machines are provided with counterweights which travel inside the pipes *F*, the pipes being hung from small trolleys so as to be readily moved along the high beams suspended from the roof. This arrangement enables the machines to be very easily handled and to be moved as far as necessary along the track. The machines contain a friction driving device which slips as soon as the bolt or nut has been tightened to a predetermined amount.

When for any special reason it is necessary to take a motor out of the line the device shown at *G* makes it easily possible to do so, rapidly and without undue effort on the part of the worker. This device consists simply of a long lever, suspended near one end by a chain from overhead and the short end provided with a pair of special tongs as shown. Dropping the hooks or tongs into position on a motor and bearing down on the outer end of the long lever makes it not only easy to

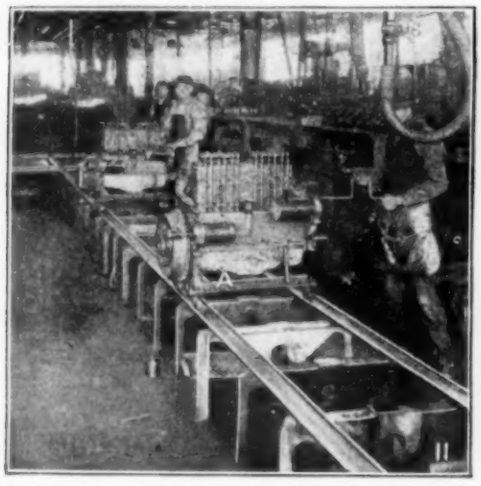


FIG. 11. FINAL ASSEMBLY STANDS

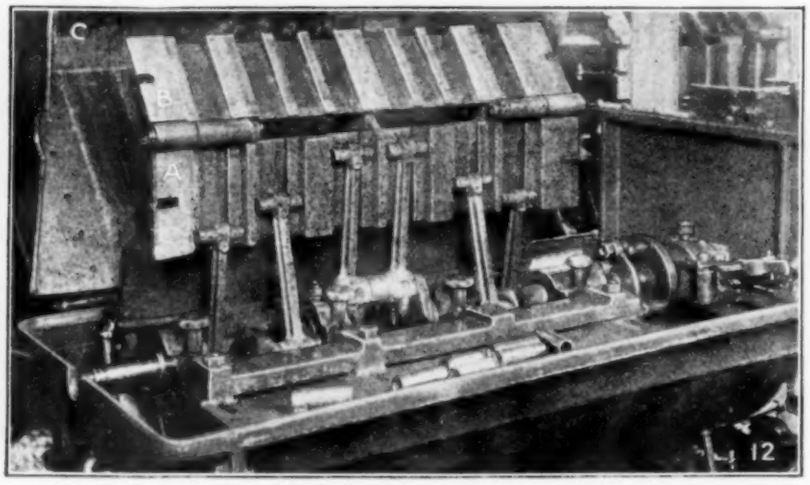


FIG. 12. RUNNING IN STUDEBAKER CONNECTING RODS

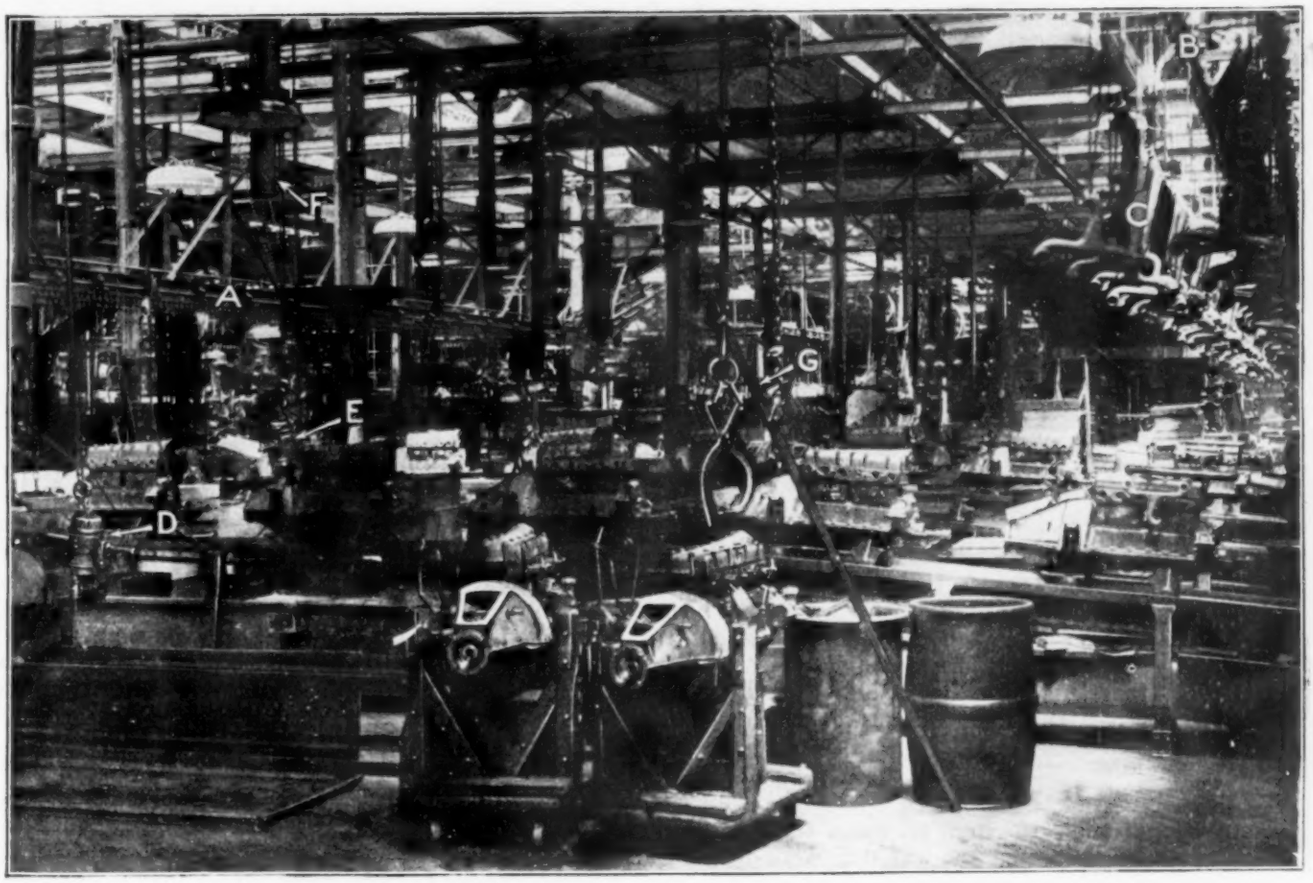


FIG. 13. A CORNER IN THE FINAL ASSEMBLY DEPARTMENT

lift the motor but to swing it out of place and on to the stand shown

After the motors pass down the tracks they come to the testing department as shown in Fig. 14. Here both manifolds may be seen in position and the motor is ready for the final running-in.

The motor is mounted on the stand shown, each stand being provided with an electric motor capable of driving it at the proper speed. Each motor is provided with a full equipment of electrical instruments and this test definitely measures the load or power required to run the motor, or in other words the friction load.

It has been found that as the motors are set up in assembly it requires about 90 amperes to start them. This must decrease to 25 amperes at the end of a ten-minute run or the motor goes back to find the cause of the extra friction. This method makes a very accurate way of measuring the internal friction of the motor, and shows the maximum friction load that will be required while the motor is new and the bearings tight.

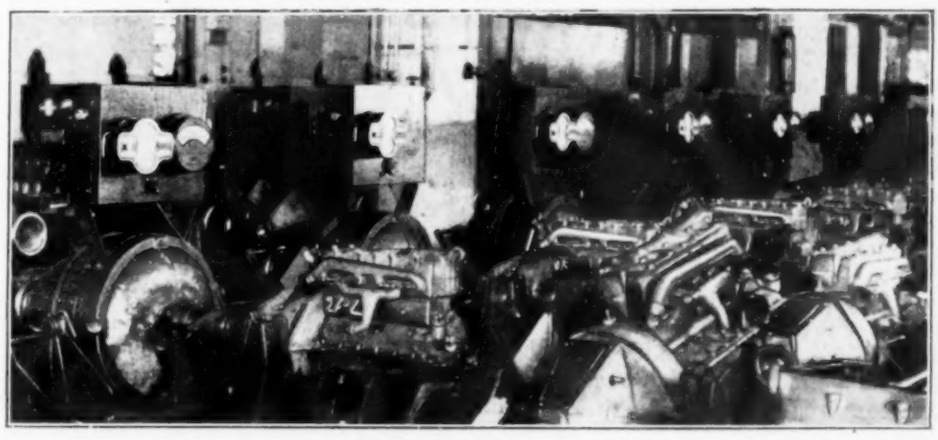


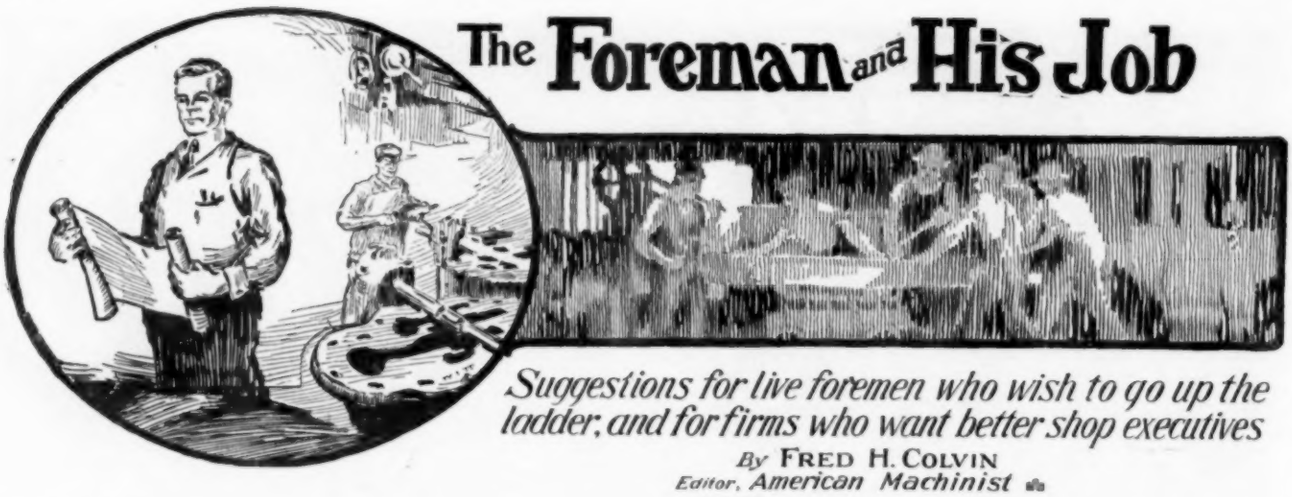
FIG. 14. RUNNING TEST FOR FRICTION

More Advice on Packing

The *Journal* of the American Bankers Association has this to say to those who contemplate going into South American markets:

The transportation problems in Central and South America are scarcely known in this country. Few people realize the transfers necessary and the various kinds of transportation used to convey an article from the United States to Bogota, Colombia, a city of 150,000 inhabitants, 700 miles up the Magdalena River and more than a mile and a half up in the air. Few people realize that ocean steamers can ply the Amazon River and its tributaries into countries on the west coast. In other words, Ecuador and Peru on the west coast have navigation facilities from both the Atlantic and the Pacific oceans.

On the other hand, most of the commerce in Central and South America travels on mule back, llama back and wagons, on difficult paths or no paths at all, and the goods must be packed properly to stand the strain and to enable them to be carried by vehicle or animal.



The Foreman and His Job

Suggestions for live foremen who wish to go up the ladder; and for firms who want better shop executives

By FRED H. COLVIN
Editor, American Machinist

THERE is a general complaint that the average worker lacks interest in his work—that quitting time and pay day are the two main factors in his mind. This is too true in many cases, but it is the penalty we have paid for over-specialization in industry; for developing machining methods at the expense of the individuality of the worker. We are learning, however, that interest can be stimulated and that it is much better for all concerned when this is done.

In the old days the apprentice often lived with the owner of the shop. He knew all about the work that came in, its difficulties and the way they were overcome. He heard the problems discussed, he saw just how the work was done and in many cases helped to do it. The machinist was of necessity an all around man who usually handled a job from start to finish and it was very natural that he should be keenly interested in it. But his interest would have been killed at once if he had only drilled one size holes in the same piece day after day, without even knowing what the piece was to be used for.

Humanizing Methods

The new methods of sub-division of work are here to stay, but they must be modified and humanized so as to consider the personality of the man who does the work. For without this you cannot secure interest, and without interest, production lags, the man becomes dull or sullen and there is no joy in the work.

Interesting men in their work may be easy or difficult, depending on both the work and the men. Exact directions or rules are out of the question, but suggestions can and will be given. These suggestions can be modified by the firm's attitude or policy, but a liberal attitude on its part will be of great help to the foreman. If the management insists on the old policy of keeping the men in ignorance of their work, the foreman who wants to climb into bigger and better work, had better hunt a new connection—he cannot grow much in such a place.

The direct question is how can a foreman help to interest his men in their work?

First of all by being sure that they understand what they are doing and why. If the department makes only a part of the complete product, let them know about this part, what it does, why it must be made well and what the output must be to keep the production of the whole plant up where it belongs. Keep the idea of quality always uppermost. Show them the advertisements and point out that it is the job of the shop to try to make every claim come true to the customer.

Be sure that each man knows just what his part plays in the complete unit. Show how slighted work will affect the whole product—how this hurts the reputation of the firm and means loss of orders, laying off of men and harms all concerned.

The Materials They Use

The more the men know about the material they work with, the better. It is another point which can be emphasized to increase interest. Where does the iron and copper and coal come from—how is it mined—how does it get here—what does it cost? How do we get brass and aluminum? What is the difference between brass and bronze?

THERE IS A GENERAL COMPLAINT THAT THE AVERAGE WORKER THINKS ONLY OF QUITTING TIME AND PAY DAY

Photographs of the product in use in various parts of the country—and of the world—together with maps with the distance marked from the factory to the different points, all help to arouse interest in the work.

If there are foreign workers, any photographs of their own country, particularly in connection with the product, can hardly fail to arouse and maintain interest.

Connecting the Worker and His Work

The main thing, however, is to connect the individual worker with his work; to make him see how his work connects with the next operation, or if he spoils this

IN THE OLD DAYS THE APPRENTICE OFTEN LIVED WITH THE OWNER OF THE SHOP

piece, that he has wasted the labor of all who have worked on it previously. The cost of the material and of the labor, the delay to the completion of the product by spoiled work, and all such problems, will help in promoting the family feeling which marked the small shop of the olden days.

Some of the more progressive shops are trying the experiment of training men to do two or more operations as a means of increasing their interest. If this means the finishing of the piece, so much the better, for the completed product means more to anyone than a small part of the work possibly can. This must be done cautiously, however, because temperaments vary widely and it may not always work. And whatever you try, do not count on perfect results every time—we are bound to be disappointed at times. A thing that will work perfectly with one man may fail with the next owing to a difference in the temperament or training of the individual.

There is another factor which must be reckoned with also. When some kinds of men have grown accustomed to repetition work they often lose the desire for a change, they become almost automatons and do not care to change. But we must not forget that men who grow to want their thinking done for them in the shop are also very apt to let others think for them outside of the shop, in civil or community life.

And we have no means of being sure that the *right* men will act as leaders. It is much safer to have men think for themselves both in the shop and out.

Mechanical Facts Usually Interest Men

The most common shop operations involve interesting mechanical facts and contain valuable lessons. They also afford many opportunities of rousing interest of various kinds and degrees, depending on the mentality of the men being dealt with. Much also depends on the personality of the foreman and the way in which he approaches the men.

When dealing with uneducated types, with men who have never had opportunities for learning, a sort of big brother attitude will usually secure confidence and interest. The main thing is to show that you are absolutely square in all your dealings, for nothing is more appreciated, even by the most ignorant.

The man who snags castings can be told about the wheel he uses, the millions of little pieces of diamond hardness that cut small pieces of metal as the wheel rubs against the iron, has its appeal to many minds, even of the helper type. The way the abrasive is made in electric furnaces with electricity which comes from the water power of Niagara or other great water falls, can be made interesting. The molding and baking of the wheel, the need of care in making the wheel so that it will not burst, and what happens when it does burst unless guards are provided, all affect the man who snags castings. The safeguards, the use of goggles, the necessity of keeping the work from jamming between the wheel and the rest, are all points which can be used in various ways.

The Cost of Things

The prices of grinding wheels and other things are always of interest, and it is a good thing to have men know what the tools they use cost. It all helps in counteracting the notion that everything beside the cost of labor and material is clear profit—and this is the cause of much discontent.

The user of drills, even on commonplace drilling operations, will be interested in knowing how drills are made and the ways in which they should be used. The motion-picture film issued by the Cleveland Twist Drill Co. on drills and drilling has proved a great help in many shops. Other films can also be obtained and the motion picture will be found a great help in many

MEN WHO GROW TO WANT THEIR THINKING DONE FOR THEM IN THE SHOP ARE ALSO APT TO LET OTHERS THINK FOR THEM OUTSIDE OF THE SHOP

ways in interesting men in the machines they use as well as in those they build.

The motion picture can show the men how coal, iron and copper are mined and made into the commercial metals which they use. In a similar way it can show

them the uses of their own product under difficult and trying circumstances. If for example, the shop product is a motor truck, motion pictures showing the trucks pulling out of bad holes, overcoming obstacles which could not be surmounted except for good materials and good workmanship, cannot fail to put a thrill into the blood of every man who helped to build them. This of course always assumes that the management is big enough to treat its men fairly and plays its end of the game fairly and squarely. Unless it does, all work of this kind is wasted. The foundation must be right and in this case *the foundation begins at the top.*

If the worker is shown how such apparently little things as the cleaning mixture for washing machine parts, the kind of slushing compound for preventing rust and similar problems, are given close and careful study by highly skilled engineers, their own jobs take on a different aspect. The importance of little things should be impressed on each man as they frequently overlook the effect of small things on the output or the reputation of the shop. In other words, the more the average worker knows about the product and the problems of manufacturing it, the better for him and for the work.

Tools and Operations in a Railroad Blacksmith Shop

Practical Value of Sample Boards, for Heavy Work—Device for Handling Forging at Furnace and Anvil—Bulldozer Dies and How They Are Used

BY FRANK A. STANLEY

THE accompanying illustrations show some of the equipment and methods used for forging and forming locomotive and car parts in a Western railroad shop.

We are accustomed to see in certain manufacturing plants, sample boards carrying parts which are made as a regular product of the factory. These samples aid in many cases in getting tools and gages made up properly, and lead to a complete understanding as to just what a particular piece is like. They may be used in conjunction with drawings, or by themselves as a check on the accuracy of duplicate parts produced in their likeness, as they can be considered models or master parts by which manufactured pieces may be checked. It is not often, however, that the sample board is used to any extent in connection with such heavy work as locomotive and car forgings. As a matter of fact, there is no place in which such sample boards are more useful than the railroad blacksmith shop.

In Fig. 1 are shown some large sample boards with forged parts made at the Southern Pacific shops in Sacramento, Cal. These boards have proved of great aid in the production of certain classes of parts. As a rule a drawing or sketch for a blacksmith in a railroad shop or elsewhere, does not carry any extra number of dimensions, and if the regular machine-shop blueprint is used there are apt to be so many figures of no importance to the blacksmith that they lead to more or less confusion. Consequently, a real sample of the forging is often an aid in keeping before the blacksmith just what the part is to be like when it leaves the anvil. He may measure or caliper any portion of the sample forging for duplication of a dimension and such samples also form a check on the accuracy of general forgings, as well as for numerous other parts.

The shops referred to above do a great deal of forging, forming and bending work and many bulldozers and other tools are used for forming engine and car parts. Some of this work is illustrated in the accompanying half-tones. In Fig. 2 is shown a frame forging under way with the work in the fire and the outer end clamped between angle sections *A* for holding in the chain sling. The forging is turned by a form of pilot wheel *B* which enables the work to be handled in the fire and under the hammer without difficulty.

Bulldozer dies are used for forming draft sill reinforcing plates, truck frame parts, car corner irons, drawbars, carry-irons, etc. The dies shown in Fig. 3 are for manufacturing push-pole corner irons for box cars. The corner iron as formed is shown resting on one of the dies at the right. Corner irons are made right- and left-hand, two of each for a car. The material is open hearth steel $\frac{3}{8}$ in. thick, sheared to $7\frac{1}{4}$ in. wide and measures, after being formed to a right-angle, $3\frac{1}{2}$ in. on the one leg and $15\frac{1}{4}$ in. on the other. The plate of metal is heated and placed in the dies. One stroke of the bulldozer does the work of forming the pocket and at the same time the corner is bent to a right-angle as

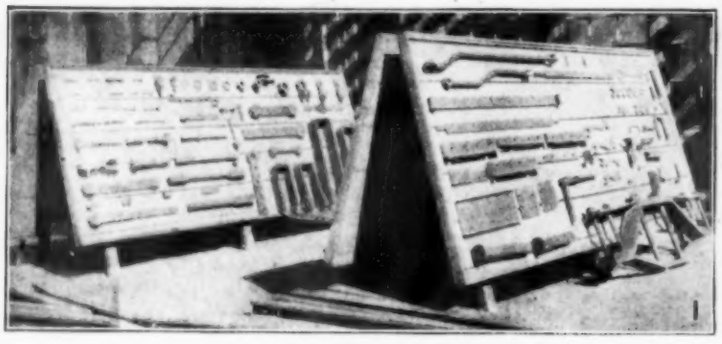


FIG. 1. THE SAMPLE BOARDS

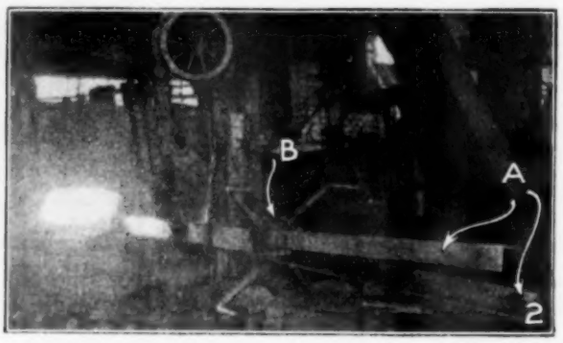
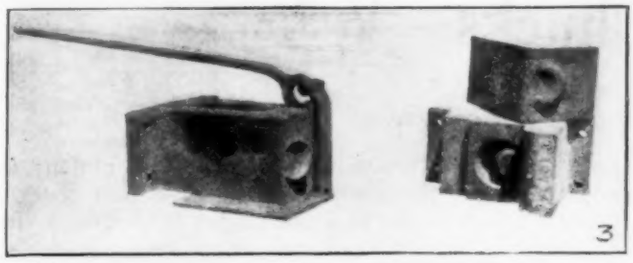


FIG. 2. A FRAME FORGING IN THE FURNACE



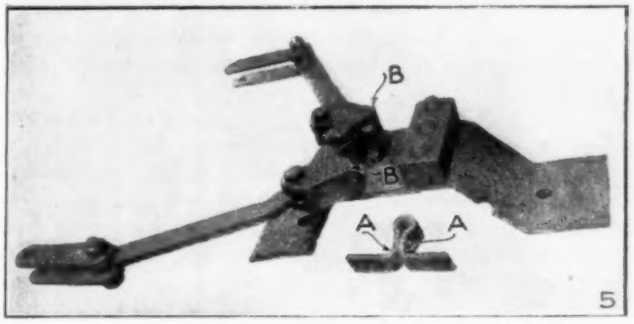


FIG. 3. DIES FOR CORNER IRONS
FIG. 5. BENDING DIES FOR FLOOR RACK HINGES

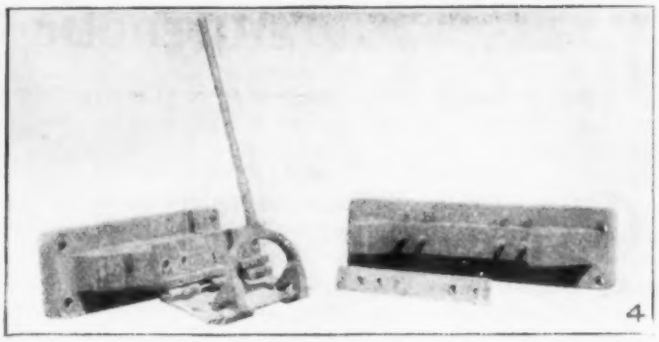


FIG. 4. DIES FOR DRAWBAR CARRY-IRONS
FIG. 6. DIES FOR BEADING TOOLS

shown. The dies are made of cast iron. The lever clamps the work for the forming operation. This lever is connected by a bolt to the upper end of the clamping strap and the lower horn on the fork bears against a lug on the die so that when the handle is pulled down a powerful clamping effect is exerted to hold the work against the die. The pocket in the work is 1½ in. deep from the highest point, while near the corner of the iron it runs out to nothing so that its circumference is approximately two thirds of a circle.

The dies in Fig. 4 are for making draw-bar carry-irons for flat cars, one of the formed irons being shown under the punch in the illustration at the right.

The operation in the bulldozer dies is forming the ends of the carry-iron at right-angles to the body, and the punching of four ⅞ in. holes for bolts by which the part is afterward secured in place on the car. The material is 1 in. thick by 3 in. wide and the work is performed in the one heat.

Clamping the metal for the operation is accomplished by means of the hinged plate at the front of the die and the forked lever pivoted to the plate. The plate is provided with four clearance holes for the passage of the piercing punches and acts as a stripper for them upon their return stroke. The die block carries a steel face in which are inserted four steel dies, that are readily kept in good condition and easily replaced when worn to a point where no longer serviceable. Similarly, the four piercing punches are secured in the head by screws which allow the punches to be removed for sharpening or replaced when worn out.

The dies in Fig. 5 are bending and forming tools for hinges for floor racks used on refrigerator cars. This outfit is used in connection with a pneumatic machine having a horizontal piston connected to a toggle arrangement, for closing the jaws and bending the hot pieces of metal around the forming post at the center of the device. At the same time the jaws, in swinging around under the toggle action, form the right-angle bends in the metal at *A* and *A*; also around the corners of the jaws at *B* and *B*. A variety of work can be accomplished on this type of apparatus, different jaws of special character being used for the different classes of jobs.

Beading tools for boiler tubes are used extensively in the shops and are made in quantities for both fire and superheater tubes in the dies shown in Fig. 6. The

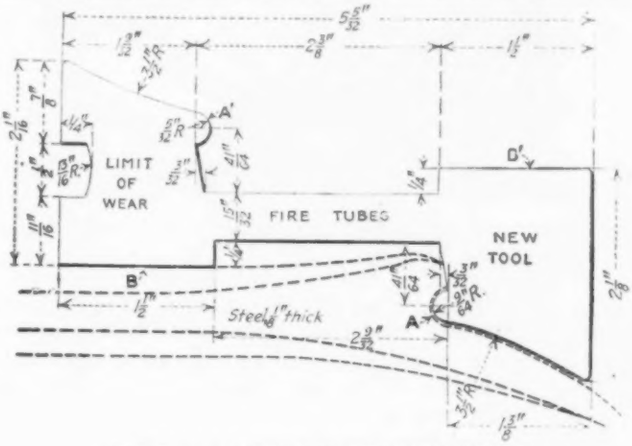


FIG. 7. A GAGE FOR BEADING TOOLS

tools wear, particularly at the throat, where the impact is taken against the work and it is important that the degree of wear and consequent change of shape at this point be held within certain limits and so checked by suitable gages that the tools may be corrected or replaced when the wear has reached the limit established by the gages. One of the beading tools is shown lying on the top of a forging die. In making these tools in quantities of, say, several hundred at a time, the annealed octagon steel is cut to length and the 1⅛-in. diameter shank is turned to its length of 2⅜ in. Then the blanks are heated and the operations of flattening, punching and forming the beading ends are performed by the dies. The fins are removed, the edges rounded and the tools are hardened and tempered. One of the gages referred to is shown in Fig. 7. The end at the right is for the contour of a new beading tool, the other end is for limit of wear as the tool is used. Thus at point *A* the gage has a radius of ⅜ in. for the new tool while on the limit end the corresponding radius at *A'* is ⅝ in. The shank of the tool rests along edge *B* for the gaging of the new tool, and along edge *B* for gaging for wear.

Magnetic Chucks—V

By ELLSWORTH SHELDON
Associate Editor, *American Machinist*

(Continued from last week's issue)

COILS for the Blanchard chuck are wound from number 16 and 18 cotton-insulated copper wire. There are two coils in the 16-in.; four in the 26-in.; and five in the 30-in. chuck. A set of coils for the larger chuck is shown in Fig. 81 ready to be put in place. The coils shown on the truck in Fig. 82 have just come from the winding machine and are waiting to be taped.

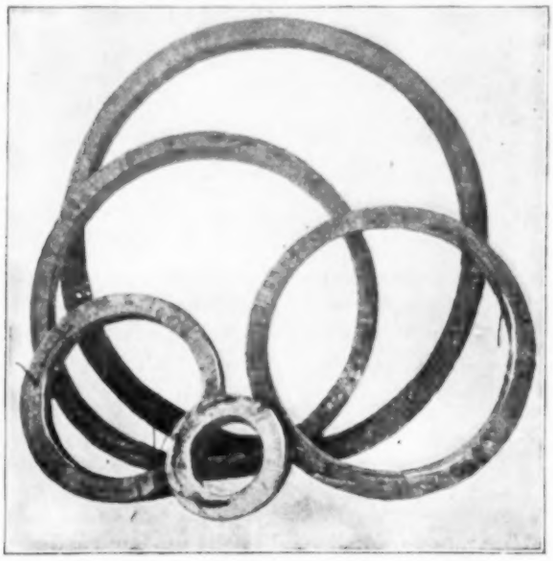


FIG. 81. A SET OF ENERGIZING COILS FOR A 30-IN. CHUCK

The coil winding and taping apparatus is shown in Figs. 83 and 84. The coils are wound upon separable wooden bobbins mounted upon the faceplate of the motor-driven winding device, which may be seen to better advantage in Fig. 83. The device is started and stopped and the speed is controlled by means of a treadle so that the operator has his hands free to guide the wire.

A skill acquired by long experience enables the operator to lay on the wire as smoothly as thread is laid on a spool by an automatic thread-winding machine. When the right number of turns is laid on (a counter on the winding device attends to the measuring) temporary binders of tape are tied about the coil and the bobbin is removed. After a sufficient number of coils are wound and tied they are wrapped with tape by the ingenious machine shown in Figs. 84 and 85.

Although this taping machine is a regularly marketed product its application is limited and it is therefore not well known. Because it is one of those devices the operation of which seems so obscure, yet when in operation is so extremely simple as to make the observer exasperated to think that he did not understand it at once, it will be described.

The C-shaped part of the frame *A*, Fig. 84, covers and forms a bearing for an interrupted ring of brass having gear teeth upon its periphery as shown in the perspective, Fig. 85. This ring is driven by two pinions spaced far enough apart so that despite the open part of the ring the gear will not run out of mesh with both pinions at the same time, and the pinions are both geared from one driving shaft so that the ring turns as readily and continuously as if it were a complete circle. The table clamps to the bench before the machine at the right height to bring the coil that is to be taped to the center of the winder. Radially disposed rollers in this table facilitate the handling of the heavy coil.

Placing a coil in position as shown in Fig. 84 the free end of the tape, drawn from a spool under the table, is wrapped by hand two or three times around the coil and drawn taut so that it will not pull away. The machine is then started and the revolving brass ring, carrying the tape with it, wraps tape around the coil as the latter is turned slowly on its axis by hand so that the tape is laid spirally. The reader will probably want to know at this juncture why the tape does not wind up on the outside of the brass ring; it does—that is why there are rollers in the channel of the ring; but the tape that is wrapping around the coil is being drawn from the *underside* of the rapidly increasing skein that is being wound onto the ring.

After the ring has made about twenty revolutions, wrapping during this time twenty turns of tape around the coil and also wrapping twenty turns about itself, it is stopped and the tape leading to the spool is cut. Upon starting again the ring continues to wrap tape about the coil, still drawing from the underside of the skein, until the wrapping is finished or the supply of tape exhausted. If the tape has been cut from the spool at the right time, these two conditions will be reached simultaneously. After the taping is finished the coils are ready for the insulating compound by which they are protected from moisture. The machinery for impregnating them consists of two tanks, one of which can be sealed against atmospheric pressure, a vacuum pump and an air pressure pump. Both tanks contain steam pipes for heating the impregnating compound. Coils to be impregnated are loosely overlaid (individually, and by hand) with a cheap porous tape and then stacked in the vacuum tank, which at this stage is empty. After the tank is filled with coils it is closed and sealed, the air exhausted, and the steam turned on. The coils are thus heated and dried in what is nearly a complete vacuum.

FIG. 82. COILS WOUND READY FOR TAPING

When a sufficient time has elapsed to insure that the coils are thoroughly dry, a valve in the pipe connecting the two tanks is opened and the liquid compound, having in the meantime been heated by the steam pipes in the

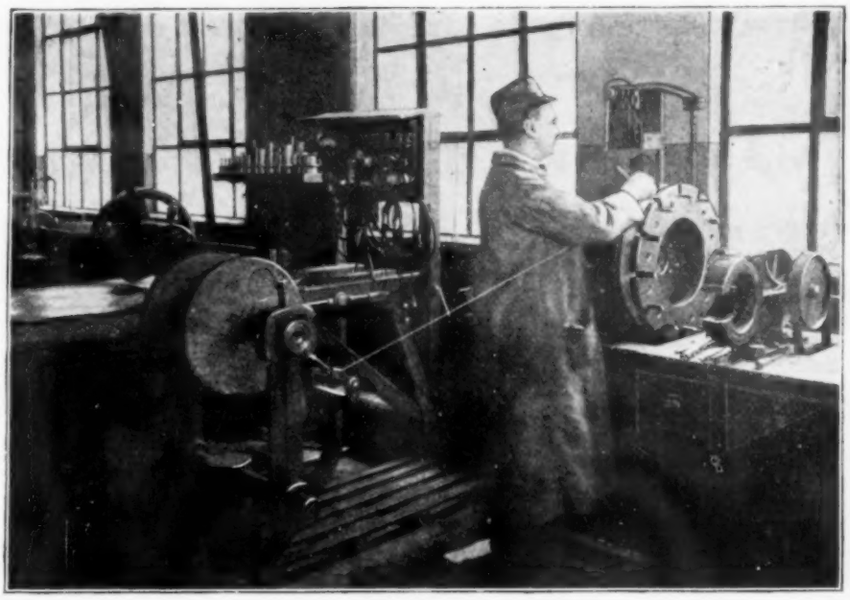


FIG. 83. WINDING A COIL

open tank, is drawn into the vacuum tank, covering the coils.

When the vacuum tank is full of compound the connecting valve is closed, air admitted to the tank, and finally air pressure is raised by the pressure pump, driving the impregnating fluid to every part of the coil.

Remaining under pressure for some moments in the hot liquid, the connecting valve is again opened, when the air pressure on the surface quickly drives the liquid back to the open tank. The excess of air pressure in the vacuum tank is now released, after which the tank can be opened and the coils taken out.

The object of the preliminary covering is now evident, as this outer layer is stripped off, taking any excess of compound with it and leaving each coil smooth. A coil thus treated is reasonably safe from the intrusion of moisture unless the latter is accompanied by some chemical that will attack and break down the compound.

Assembling the Chucks

The operation of assembling the chucks is shown in Fig. 86. Usually four chucks are carried along together, but in this case the operations are shown in progression.

FIG. 84. TAPING A COIL

Nearest the observer is a chuck body which has been cleaned and dried ready for the assembling. Next, strips of fiber are laid on the bottom of the groove (which becomes the top when the chucks are finished, for they are turned bottom side up for assembling) and other strips are stood up edgewise at either side of each groove; the object being to forestall any possible abrasion of the coils when the latter are set in place, for it is intended to have them fit rather snugly.

In the third chuck from the observer the coils have been set in, and in the chuck next the instrument board the final filling of insulating compound has been poured and the fiber cushions or bearers which eventually take the weight of the coils have been placed. Fig. 87 shows a clearer view of this last chuck; which is ready to close. In the regular assembling operation current is turned on as soon as the coils are in place and connected up, the meters showing instantly whether or not anything is wrong with the wiring. The "main poles," as the divisions between the coils are termed, are tested before the cover plate is put on,

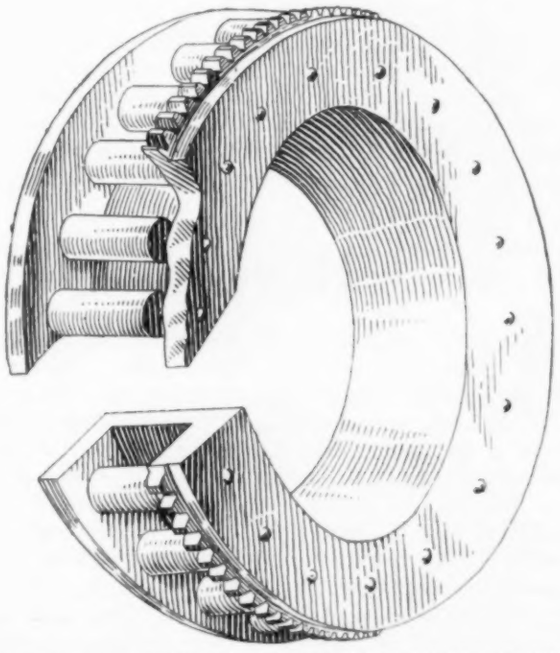


FIG. 85. PERSPECTIVE OF THE BRASS RING IN THE TAPING MACHINE

with a dipping needle which should show the poles to be alternately north and south as the center of the chuck is approached. If the needle turns over as it passes each pole it assures the assembler that the coils have been put in the right way; for it is essential to have the current flow in opposite directions in adjacent coils, else consequent poles instead of normal ones would be established and the magnetic effect would be neutralized.

The leading-in wires from the coils are not joined together from coil to coil but are all brought to the terminal block seen in Fig. 87, and here provision is

FIG. 86. CHUCKS IN PROCESS OF ASSEMBLING

FIG. 87. A 26-IN. CHUCK READY FOR THE BOTTOM PLATE

made to connect all four coils in series when the chuck is to be used on a 220-volt circuit, or to connect the inner and outer coil in series, the second and third coils in series, and the two pairs thus formed in parallel when 110-volt current is available. The current consumption in watts is the same in either case.

There is of course much more wire in the outer coil than in the others. In making up the two pairs in the above case, joining the large coil to the small one makes the combined amount of wire equal to that in the combined intermediate coils, therefore the two pairs are in electrical balance. Bringing the leading-in wires to the terminal block instead of joining them together provides a means of changing a chuck from 110 volts to 220 volts, and vice-versa, without disassembling it.

The Blanchard chuck is built for hard, heavy work and to withstand rough usage. Because much of the work that comes to it consists of rough castings, upon which the magnetic grip is far less powerful than upon smooth surfaces, it must possess more than ordinary holding power, and this desideratum is attained by the use of soft steel of high magnetic permeability for the entire magnetic circuit of the chuck; by the concentric disposition of the coils, which permits the fullest possible utilization of the space; and by the ample cross-section of the magnetic path, so that in holding work that covers large areas of the chuck surface the magnetic currents are not choked by reason of a restricted path in the chuck itself.

The Blanchard chuck shows a somewhat higher current consumption in relation to its superficial area than other chucks for the reason that the unbroken web of steel between the bottom of the brass filled grooves and the coil chambers must be saturated; but this disadvantage when compared with the amount of work turned out by the machine is so small as to be negligible.

Hardening Hammer Die Blocks

AT THE convention of the American Society for Steel Treating, in Philadelphia, Pa., a paper entitled "Hardening Hammer Die Blocks" was read by R. B. Kerr, foreman of the heat-treating department at the John Deere Harvester Works, East Moline, Ill. The methods he suggested have been in use under his direction for a number of years and are offered, as he said, "not with the idea that they are perfect, but with the hope that they may be helpful." The following is abstracted from Mr. Kerr's paper:

While die blocks can be heated successfully in either coke or oil furnaces or even in the smith's forge, a gas-heated furnace of the oven type is by far the most convenient and satisfactory for this work.

When heating dies the considerable air pressure required to burn fuel oil makes necessary the most extreme care to prevent scaling or surface decarburization in the parts to be treated. The furnace, therefore, should be of the muffle type, the heating chamber completely inclosed, or if this is not available, the die should for protection be packed face down in a gas-tight box of suitable size half-filled with charcoal, and the whole thing heated up. If the piece to be heated is of considerable size, the packing box should be made with hinged ends which fold down out of the way so that the die can be lifted out readily by grab hooks or a sling. This "safety first" method entails some extra work and inconvenience, but the results justify it. Personally, the writer can testify through considerable experience that it is better to go to some extra trouble to assure success, than to have an opportunity later on to frame up excuses that will pass when asked to explain "how it happened."

It might be said that this method of pack-hardening is excellent for heating dies and tools of nearly all descriptions. The parts come out of the packing box uniformly heated with a surface perfectly free from scale and in the best possible condition for hardening. The process is an old and successful way of heating steel. It deserves to be more widely known and practiced.

Whatever the type of furnace used or the means employed the all-important thing is to get a good heat on the die; a thorough, slow-soaking, uniform heat, for upon that depends to a great extent the success or failure of the operation. Particularly for the benefit of the younger steel treaters it may be said that thorough careful heating, more especially when handling comparatively large blocks of steel, is most essential. It is the author's opinion, based on a long and varied experience in hardening steel, that more dies and tools are ruined by careless heating than from all other causes combined.

For heating, a gas-fired oven furnace of ample capacity should be used as being most convenient and suitable for the job. If the oven is already hot, so much the better; if not, bring it up pretty well before putting in the work. Dies of any description should not be put into a cold furnace. Nothing is gained in time, and besides, some chances of surface decarburization are offered with a rapidly rising heat.

Place the die in the furnace face down, unless the nature of the impressions makes this impossible; in which event it is good practice to protect the surface from possible gases

by laying a closely fitting piece of asbestos or sheet steel on top while heating. As another precaution, if the die is of considerable size and the impressions are deep or irregular, it is well to bring it up to a dull red heat, about 1,300 deg. F., and let it partly cool off in the furnace before taking the hardening heat.

Heat slowly and regularly. The time required will, of course, vary in proportion to the heating area of the furnace and the size and shape of the piece to be treated. The average grade of hammer die steel will harden nicely at around 1,450 deg. F. and the heat always should be held stationary for at least 15 min. before removing the die from the fire.

The quenching tank should be of ample size and the water supply arranged so that it can be forced upward against the face of the die with considerable force and volume, using an overflow pipe of sufficient size to take it away. In most cases clean, fresh water is all that is necessary, but if extreme hardness is required or if the water is soft or muddy, river water as an example, the addition of a little salt will sharpen it. If this is done, a loosely woven sack filled with salt and suspended in the tank will be found most convenient. Place a resting rack across the top of the tank, arranged at sufficient depth so that the impressions on the face of the die will be well covered with water when the die is laid on it. On flat surfaced dies or on dies in which the impressions are shallow, a depth of from 1 to 1½ inches is about right.

When all is ready get the piece out of the fire. If there are any dangerous looking corners or sharp projections that do not need to be hard, partly cool them off with a water jet or piece of water-soaked waste to prevent chipping. Place the die on the testing rack face down and turn on the water. If the piece is wide or flat, prevent warping or crowning by keeping the back slightly cooled off; just enough water and no more. Run the hand over the face frequently to find how it is cooling off.

Never let a die cool off entirely in the water. Whenever the face is cool enough to prevent the temper from drawing, get it out as quickly as possible and lower it into the oil tank. Keep the die moving or agitate the oil.

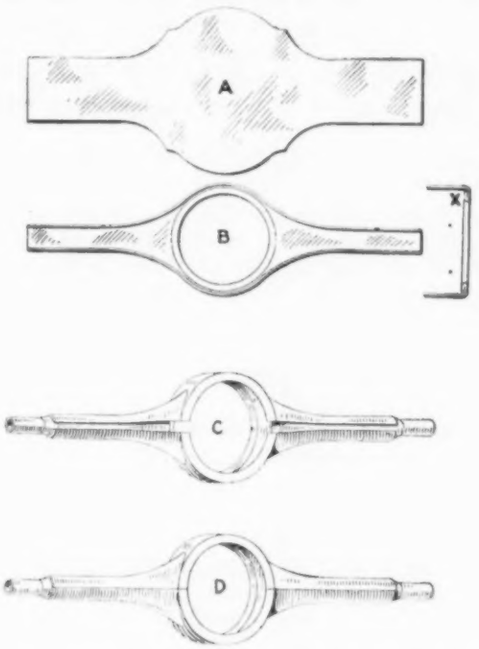
The temper should be drawn slightly on all hammer dies, both to relieve strains and to give them resiliency or spring, as well as for better wearing qualities, and the drawing should be begun immediately; even before the die is quite cooled off. If there is an oil tempering furnace large enough at hand, get the piece into it. Raise the temperature to around 400 deg. F. and hold it there for an hour or so. If for any reason this method cannot be used, swab the die with light machine oil and place in a furnace partly cooled off. Leave it there until the oil begins to flash, then remove and allow it to cool off in the air.

As stated above, a die should never be allowed to cool off entirely in the water. When a mass of steel at the hardening temperature is plunged into cold water, the grains in its outer surface immediately become set and rigid. A certain amount of contraction and shrinkage also takes place, partly because of the change from high to a low temperature and also because of the hardening of the metal. The amount of this shrinkage is in exact proportion to the surface area of the mass being treated; the greater the area the more the shrinkage. If this change took place all the way through there would be no trouble; but it does not. In the first place, the interior of the piece cools off much more slowly than the outside and secondly, the setting of the grains due to hardening extends in a depth of from ⅛ to ¼ in. at the most. This suddenly chilled outer layer is consequently being forced against the softer mass inside with an enormous pressure, causing distortion and strains which become more marked as the piece cools off. When the temperature recedes to a certain stage, governed partly by the temperature of the quenching water and the air, a violent action takes place. This is the danger point. The friction created by the molecules striving to adjust themselves to the new conditions generates heat inside; heat means expansion, and unless this condition is offset promptly by heat applied to the outside to relieve the strains, the die, particularly if a large one, has about an even chance of bursting open. Whether it does or not, the strains are there and are just as liable to manifest themselves in service later on as they are to appear immediately after hardening.

Allowing the dies to remain in the water too long and failure to draw the temper promptly after hardening is responsible for considerable breakage. This is partly due to the lack of proper equipment, and also to the fact that the principles involved are not so generally understood as they might be even among steel hardeners. This heat generation by friction or, as some might call it, molecular reaction inside of a body of steel, is no pet theory, for the author has noted its effects during many years of close observation and practice in the heat-treating of steel. Furthermore, he believes it will be found in line with the natural laws governing cooling bodies. Be that as it may, the writer has found this method of hardening dies a success and can recommend it to steel treaters who are having trouble.

Erratum—The Columbia One-Piece Axle Housing

In describing the machining operations on the Columbia axle on page 27 of the issue of January 6, 1921, the statement was inadvertently made that the Columbia axle housing was made of two parts welded together.



THE FOUR STAGES OF AXLE HOUSING CONSTRUCTION

In reality the axle housing is constructed of a single piece of sheet metal so that only one weld is necessary.

The development of this axle housing from the flat sheet is shown in the accompanying illustration, in which *A* shows the blank before forming, and *B* after the first operation in which the center is drawn as shown in the sectional view at the right. It will also be noted that the center is considerably stiffened by turning in a thickness of metal as shown at *X*. This also affords sufficient thickness for tapping for the cover plate.

The operation shown at *C* folds the housing over the end tubes, while *D* shows the housing completely closed and in place ready to be welded along the single seam shown. This construction makes an exceptionally stiff axle housing and one which differs from the usual two-piece construction in the manner shown.

Ideas From Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered and those published are paid for.

Air Blast by Induction

By Frank Richards

There are some facts that should be known about the economic use of compressed air, facts which we might know and remember, if there were a way of impressing them upon us.

In most industrial establishments of the present day there is a regular supply of air at 6 or 7 atmospheres, (75 to 90 lb. pressure), distributed throughout the works and constantly on tap whenever it may be required for operating pneumatic tools and other purposes, and it is a very common thing to use such air direct for blowing or for various purposes where air at very low pressure would do the work. The waste of air in this way is enormous and the only reason is in the failure to provide simple devices by which such wastes might be avoided.

As a practical object lesson I wish to call attention to the two halftones.

Take a piece of paper mailing tube, or roll up a sheet of paper about 1 or 1¼ in. in diameter and 6 or 7 in. long. Place one end close to your mouth as in Fig. 1, and blow hard holding your other hand 3 or 4 in. from the other end to feel the effect of the blast. Then hold the tube 3 or 4 in. away from your mouth as in Fig. 2 and blow through it, holding the hand up as before to feel the effect.

The actual result is astonishingly the reverse of what the common supposition is. In the case of Fig. 1, with the tube held close to your mouth, you do not feel a blast of air against your hand at all, while in Fig. 2 you feel it strong. Try blowing at a lighted candle. With the tube as in Fig. 1, the candle will not be blown out, while with the Fig. 2 position it is extinguished at once, even if held at some distance from the tube.

The explanation is: the centralized and concentrated jet of air, Fig. 2, draws into and carries with it a considerable quantity of air. In Fig. 3 we have the air flowing from one pipe *A* into another pipe *B* with an open space between them, and the arrows suggest the inrush of outside air to increase the volume. In many cases it might be practicable to have another open space

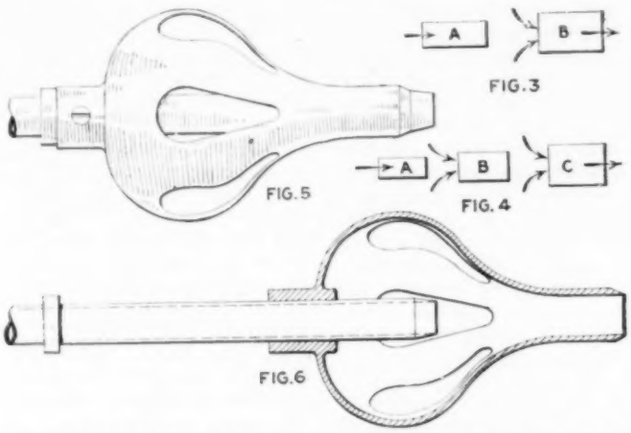


FIG. 3. AIR GATHERS VOLUME BEFORE ENTERING TUBE *B*. FIG. 4. SHOWING HOW VOLUME INCREASES. FIG. 5. AIR INDUCTION NOZZLE SET FOR FULL PRESSURE DIRECT BLAST. FIG. 6. AIR INDUCTION NOZZLE SET FOR MORE VOLUME WITH LESS PRESSURE

and another pipe *C* (see Fig. 4), the ultimate effect being thus still more increased.

Concerning the power consumed, as there is no getting something for nothing, pressure is simply exchanged for volume, this being carried so far in some cases as to increase the original volume under high pressure (see Hiscox) as much as 30 times, but only with final pres-

FIG. 1. NO BLAST IS FELT ON THE HAND. FIG. 2. BLAST IS VERY NOTICEABLE. LIGHTED CANDLE MAY BE BLOWN OUT EASILY

sures approaching atmospheric. Or there may be a considerable increase of volume with some of the original pressure retained, as for the blowing of metal furnaces or blacksmith fires.

In places where compressed air is supplied, it is common practice (the wastefulness of the direct air blast being more or less understood) to rig up an induction blast by means of an ordinary pipe and fitting using a tee or a cross with a small compressed air nozzle discharging a jet into the middle of the fitting and drawing in free air through the side openings to mingle with it. Such an arrangement will, with one quarter the amount of compressed air or less, do the work of blowing a fire or anything of that kind.

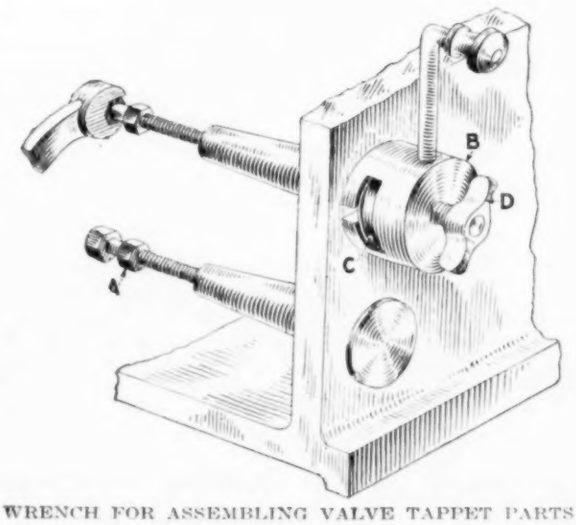
No one, surely, need be told that the air induction nozzle shown in Figs. 5 and 6 would be more economical of air and more satisfactory in every way than any cobbled-up arrangement of standard pipe fittings. Fig. 5 gives a direct blast of air at the full pressure. The air delivered by the internal jet in Fig. 6 is largely augmented by the free air drawn in through the side openings in the head. This head may be adjusted and fastened in any position that experiment may determine to be most effective.

An investigation of the possibilities and limitations of air induction would be very profitable for our experimental physical laboratories to engage in, and information and data of great value to users of compressed air might result.

Special Wrench for Assembling Gas Engine Valve Tappets

By J. H. Vincent

A well-known gas engine has valve tappets in which hexagon-head screws, as shown at *A* in the illustration, are driven for a considerable depth to be used later for



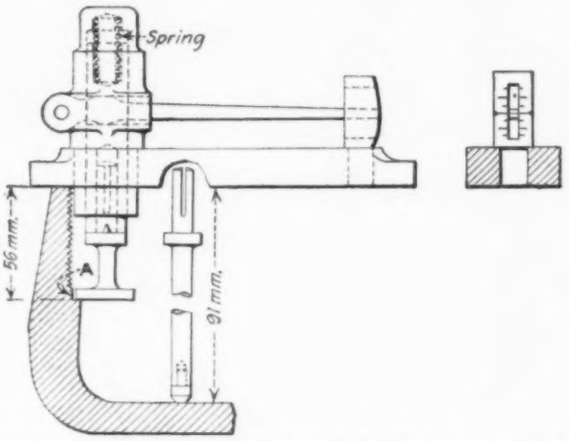
WRENCH FOR ASSEMBLING VALVE TAPPET PARTS

adjustment of the tappet rods. The assembler was supplied with the special wrench shown at *B* which greatly facilitated setting in the screws. The slot *C* in the body of the wrench is slipped over the head of the tappet which is then locked securely in place by a turn of the thumbscrew *D*. Taking the handle of the wrench in one hand the workman rapidly revolves the tappet while he holds the head of the screw with a S-wrench in the other hand. The operation is thus very quickly completed.

Aero-Engine Cylinder Depth Gage

By James McIntosh

The Aëronautical Inspection Department (British) had a very rigid inspection department to assure accuracy of "spares" in the field. Cylinders were held



AN INDICATOR TYPE DEPTH GAGE WITH A NUMBER OF DIFFERENT LENGTH ENDS FOR SEVERAL DEPTHS

to very close limits. After the liners were fitted they were gaged from a surface used as a base line. The seat *A* for the liner was 56 mm. from the base line. The end of the liner was beveled in order to make a tight fit, being screwed into the aluminum head after the head was heated. The depth of the head was 91 mm. These distances were held within limits by the indicator type gage shown in the illustration. Three depths were inspected by transferring different length rods, which were split to make a spring fit in the end of the gage spindle.

Chart for Determining the Pressure on a Cutting Tool

By J. B. Conway

It is often desirable when designing tools, and necessary when designing a machine for removing metal, such as a lathe or planer, to know the pressure exerted by the metal upon the tool removing it. Extensive experiments of Mr. Taylor and Dempster Smith, the latter of Manchester, were conducted for the purpose of arriving at some definite idea of this pressure, and the former has embraced the results of these experiments in the formulas which follow.

The pressure, naturally, is dependent upon the character of the material being cut and varies with the hardness, depth of cut, and the feed. In turning, there is also the side pressure created by the feeding of the tool parallel to the axis. The experiments cover cast iron and steel, the former being divided into two classes, namely, hard and soft cast iron. In order to solve the formulas, the three quantities mentioned must first be predetermined or known. In machine design, the maximum feed and depth of cut that would likely be required of the unit would be assumed, while in the design of a tool, fixture or auxiliary equipment for the fastening of a part to be machined the factors in the formulas would be governed by the current shop practice.

The total pressure in pounds on the tool when cutting is found as follows:

For steel, $P = C \times D^{0.933}$

For cast iron, $P = C \times D^{0.933} \times F^{0.75}$,

when P = pressure on tool; C = a constant; D = depth of cut; and F = feed in inches. C = 230,000 for steel, 69,000 for hard cast iron, and 45,000 for soft cast iron. If any considerable amount of calculating is required, the character of the formulas necessitates the use of logarithms and, at best, is tedious. The accompanying chart has been designed for the purpose of rapidly solving the equations and gives, as well, a visual comparison when different values are assigned to one or more factors.

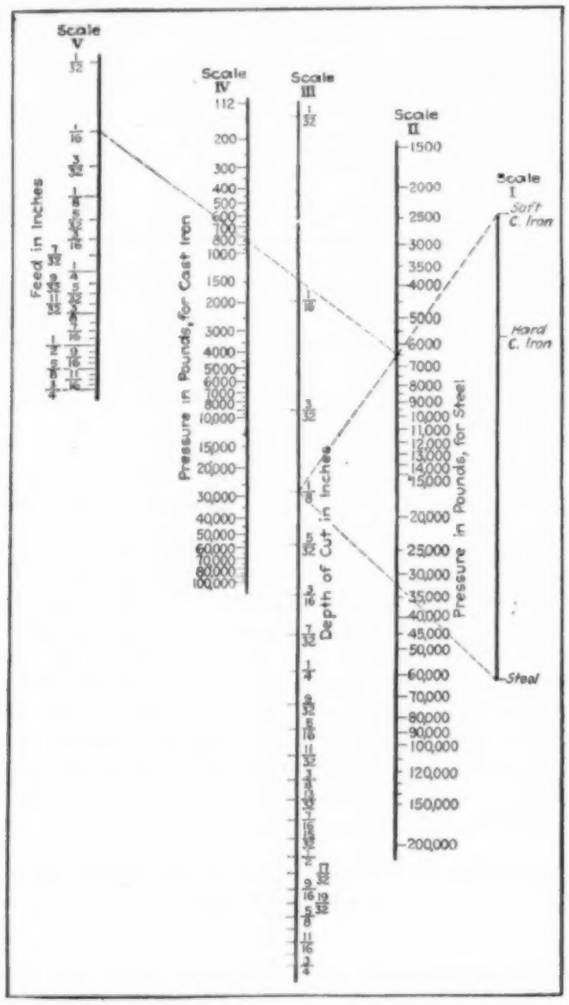


CHART FOR DETERMINING PRESSURE IN POUNDS AT CUTTING EDGE OF A TOOL WHEN FEED IN INCHES, DEPTH OF CUT AND NATURE OF MATERIAL ARE KNOWN

Based upon the following formulas, from Mark's Mechanical Engineers' Hand Book. For steel, $P = C \times D^{0.933} \times F^{0.75}$; For cast iron, $P = C \times D^{0.933} \times F^{0.75}$; when F = feed in inches, D = depth of cut in inches, C = constant which is 230,000 for steel, 69,000 for hard cast iron and 45,000 for soft cast iron.

To read the chart proceed as follows:

For steel, connect point on scale I marked "Steel" with the depth of cut in inches on scale III, and on scale II read the pressure in pounds. For cast iron, connect point on scale I with depth of cut on scale III; thence from the intersecting point on scale II swing the straight-edge to the feed in inches on scale V, and on scale IV read pressure in pounds.

An example will perhaps serve best to make the use of the chart clear. Assume that it is required to find the pressure exerted at the point of a tool cutting steel, with a depth of cut of $\frac{1}{8}$ in. (0.125 in.). First, lay a straightedge on the chart connecting the point on Scale I with the "depth of cut" on Scale III; then on Scale II read the pressure in pounds.

For cast iron, first determine the degree of hardness of the material, whether "hard" or "soft"; then with a straightedge connect the corresponding point on Scale I with the depth of cut on Scale III; from Scale II, at the intersection of the straightedge with the scale, swing the former to the "feed in inches" on Scale V; then on Scale IV read the pressure in pounds.

In the examples shown on the chart, for the first we obtain 32,890 lb. when cutting steel, and 850 lb. for soft cast iron. Other examples could be given, but these two should enable one to readily use the chart. It may also be employed inversely, as to find the feed when the depth of cut and pressure are assumed, for cast iron; or the cut, when the other factors are known or assumed. It will be noted that in the formula for steel no mention is made of the "feed," and it is assumed that this formula is in such form that both factors are covered, which perhaps could not readily be accomplished in the case of cast iron. It would, however, be convenient if this factor were given separately.

In order to arrive at the result by solving the formula by ordinary methods the following procedure would be necessary. Using "logs," for the first step we have

$$\text{Log } 230{,}000 + (0.933 \times \text{Log } 0.125) = \text{Log } P.$$

And for the second example,

$$\text{Log } 45{,}000 + (0.933 \times \text{Log } 0.125) \times 0.75$$
$$\text{Log } 0.0625 = \text{Log } P.$$

The convenience of the chart will be appreciated by those who have occasion to employ logarithms and know the confusion at times resulting from the use of negative characteristics, which characteristics in the above formula are all negative, as the values for D and F are all less than one.

In the solution of problems such as enter into tool design, the chart will be found useful, as in the case of determining the proper sizes for "fastening" bolts, screws and clamps, particularly friction clamps or those dependent upon pressure from above to obtain holding power. For, in the second example, where the pressure was found to be 850 lb., this pressure multiplied by the radius would equal the turning moment, or the force which must be counteracted by proper fastenings to prevent the part being machined or turned from slipping. Also, it would be employed as a basis for determining the size of bolts or screws to be used.

From the initial pressure, the component and resultant forces acting upon the tool equipment can be arrived at and are determined by the several angles on the tool which are in contact with the work. Thus, the downward and lateral pressures can be found for enabling one to proceed further with the design. It is, of course, common knowledge that these pressures and forces exist, but before the formulas were made public very little was understood concerning their actual values, and the design of equipment was largely a matter of experience and good judgment.

Novel Use for a Valve Grinding Attachment

BY E. A. DIXIE

I was recently in a shop where one of the drilling machines is permanently fitted with a valve grinding attachment. You know the thing I mean; mechanism whereby the spindle of the machine is caused to make say three quarters of a turn forward and then a fraction of this backward, so as to simulate the hand operation of valve grinding.

In this shop the device is, as a general thing, used for the purpose for which it was built but the other

day I saw it at a new job and it was doing it just as satisfactorily as it does the old one.

One of the cub apprentices had drilled a lot of castings ready for tapping. The tapping was to have been done on a vertical tapping machine but the cub had make a mistake and the holes were so small that the machine driven tap would not stand up to the job and broke off.

All the other drilling machines with the exception of the one with the valve grinding attachment were tied up on long runs at the time. However so many fixings had been put on it to make the valve grinding attachment a permanent affair, it would have been a big job to make the spindle run continuously in the one direction, so that the holes in the castings could be re-drilled to correct tapping size.

The superintendent is a resourceful man; he sent to the tool crib for a ⅜-in. hand tap and tap wrench and tapped one of the holes by hand, turning the tap right handed till it stuck and then backing it out a little to break and clear the chips. Having proved to his own satisfaction that the holes were large enough to tap in this manner the tap was mounted in the chuck in the spindle of the valve grinding machine and the same cub set at the job of tapping.

The valve grinding machine gave just the required motion, the tap being driven right-hand for three quarters of a turn then backed out for a little over a quarter of a turn, breaking and clearing the chip. While not as fast as it could have been done on the tapping machine, had the holes been drilled the correct size, the job was done in about the same time that it would have taken to re-drill and tap them.

Inaccessibility of Auto Parts

By I. B. Rich

Some weeks ago a letter in the *American Machinist* by George Little called attention to a very pertinent question in automobile design, the inaccessibility of parts which require adjustment and repair. Getting at the average motor from either above or below, is usually an all-day job. Crankcases must be tight, and the use of aluminum or sheet steel makes it necessary to find some way to overcome the spring of the metal in making the joint. Hence the multitude of bolts, lockwashers and nuts.

As a suggestion along this line I submit the plan

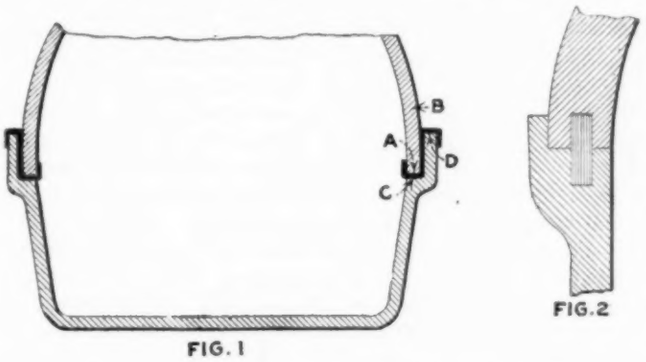


FIG. 1. THE JOINT BETWEEN PAN AND BASE
FIG. 2. ANOTHER TYPE OF JOINT

shown in Fig. 1, no bolts being used in this construction. The lower half or pan, of either sheet steel or aluminum, is designed to come up around the engine base. Between them, to form the joint, is a sort of Z-shape gasket, preferably of copper and perhaps with lengthwise corrugations, if found necessary.

The engine base *B* is finished on its lower edge *A* and the pan on its upper edge *D*. While finishing at *C* would perhaps be an improvement—it is not necessary. With a sheet-steel pan the shoulder would be automatically finished in the dies.

The clamping of the pan up against the engine base would pull the Z-gasket into contact at *A* and *D*—the

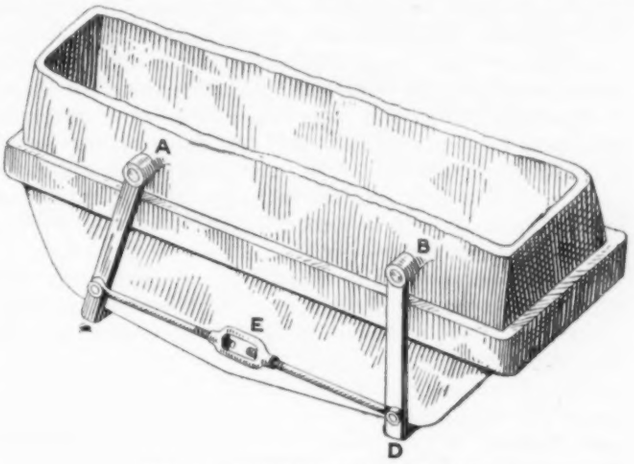


FIG. 3. SUPPORTING THE PAN

shoulder merely supporting the gasket against *A* but the real oil seal being at *D*. Another form of seal is shown in Fig. 2. Here a channel is cast in the base and pan—or formed in the latter, if of steel, and a felt washer inserted as shown. The first method is probably more satisfactory.

The pan is then held in place by clamps shown in Fig. 3. These can be of many varieties. As shown they are stirrups or U-straps hung from *A* and *B*. They can be made to swing clear of the ends or to unhook from the top when released. As shown they are drawn together by a turnbuckle at each side of the case. This is preferable to having a single fastening at the bottom on account of the possibility of its being knocked off or distorted by a rock or high spots in rutty roads. This is only one of many ways of accomplishing the desired object of eliminating the multitude of bolts on the crankcase. With this device a pan should be taken down in ten minutes and replaced in the same time.

Know Why You Do Things

By H. G. W. Reichenbach

On page 367 of the *American Machinist*, A. W. Forbes writes about setting tools on a lathe. He mentions that it lies with the machinist to use his own judgment whether tools should be set on the level with, under, or above the center. I thoroughly agree with Mr. Forbes.

I know from experience that in cutting off stock of large diameters, I have found it satisfactory to set my cut-off tool slightly above center and as the tool got nearer to the cut-off point or to the center, I would have to set it lower—that is, level with the center.

I have also found out from experience that the best and quickest way to cut off a piece of stock (regardless of diameter), is to turn the tool upside down, set the cut-off tool at dead center and run the lathe backward. Care must be taken to set the cut-off tool exactly square with the stock to be cut off. In this manner I have cut off 6-in. cold-rolled steel inside of five minutes.

IN THIS ISSUE

WE HAVE read with a great deal of interest Colvin's first article on the American Rolls-Royce, which opens this issue. After studying the methods employed to obtain accurate parts and the care taken to maintain a very high standard in quality of material we can easily understand that the makers are justly proud of their product. The current article is the forerunner of a series on the Rolls-Royce, the individual articles of which will be announced from time to time in "Coming Features."

The second article this week, beginning on page 628, introduces a new contributor and an unusual subject. They are Joseph Kaye Wood, an engineer of the Western Electric Co., and helical spring design. Wood bases his calculations upon two original terms which he introduces in this way: "I have had occasion to design and investigate many small helical springs, which led me to realize the urgent need of some systematic arrangement of the many factors that enter into the design of these springs. Consequently I have written the following article, bringing out an apparently new fact and several corollaries to it, which simplify the design of helical springs both small and large. In this connection I found it convenient to create two new terms: 'spring criterion' and 'material index.' The fact spoken of is as follows: That the spring criterion must not exceed the material index in order that the helical spring in question will be able to safely carry the maximum load as computed from the ordinary deflection formula." If we were designing many helical springs we should certainly give this article careful study to see for ourselves if someone hadn't been kind enough to make our task easy.

Western Editor Hunter has supplied a description of the Defiance inverted spindle drilling machine that has only recently been placed on the market. Hunter's description goes far enough into detail that when you have read it you will feel that you are well acquainted with the machine. Page 633.

In the eighth installment of "Metal Cutting Tools" DeLeeuw continues his consideration of milling cutters. Chip breakers, spiral teeth, face mills and end mills are the subjects treated.

The Essex, Oakland and Ford methods are described under "Methods of Motor Assembly," page 641. The article tells of the assembling of the Essex pistons and connecting rods, testing the squareness of the pistons, and of the testing room and motor stands; of the application of connecting rods and pistons to the cylinder block of the Oakland and of the "burning-in" of the crankshaft bearings; and finally of the use of conveyors is assembling Ford motors, the application of transmission covers and manifolds and of measuring the friction of the motor.

"The main thing is to connect the individual worker with his work; to make him see how his work connects with the next operation, or if he spoils this piece, that he has wasted the labor of all who have worked on it previously. The cost of the material and of the labor, the delay to the completion of the product by spoiled work, and all such problems, will help in promoting the family feeling which marked the small shop of the olden days." You will, of course, recognize the foregoing as coming from Colvin's "The Foreman and His Job." It begins on page 646.

Stanley, it seems, has an inexhaustible supply of good things to tell us about railroad shop methods and devices. His article this week is short but at the same time it tells a whole lot about blacksmith tools and operations. Bulldozer dies and sample boards receive particular attention. Page 648.

Part five of "Magnetic Chucks" is concluded in this issue beginning on page 650. It deals with the Blanchard chuck, dealing with winding, taping and assembling.

Many have grown rather pessimistic, at times, because business is slow. By comparison with conditions in some other countries, we are well off. The reports from our London and Berlin correspondents, pages 664a and 664b, show that conditions in England and Austria are poor indeed. "Assertion is made that British industry is fighting for its life," is the report from England; and the Austrian letter says that "politically the critical stage may be said to be past but economically the country is still in a very precarious position." There is, however, here and there, improvement indicating a brighter future.

Coming Features

The next issue is to be devoted entirely to complete articles, which means that those of our readers who are following the series articles will have to forego that pleasure for a week. The articles selected for the coming issue are somewhat unusual and we believe that you are going to start in with the first and read straight through. They deal with such subjects as machine shop operations on textile machines, construction and repair of sugar machines and methods in a shipbuilding plant.

Looking a little farther ahead, we find that we are ready to announce a new series, "Tool Engineering," by Albert A. Dowd and Frank W. Curtis of the Albert A. Dowd Engineering Co. of New York City. The series is devoted to jig and fixture design and related subjects and is planned to cover a very wide range. The first article will be published two weeks hence.

EDITORIALS

Working Two Shifts!

FROM New England comes word of a machinery building plant which is running two shifts. It is not a large plant as manufacturing plants go, but neither is it a small one.

What is more, the men are working on a fifty-hour-week basis. It sounds almost like good times, for one little group of men at least.

A good augury for the future is the fact that this particular company is eight months behind on one of its models. In this connection it might be well to add that the management is not at all apprehensive of cancellation troubles.

As we have intimated before it takes more than one swallow to make a summer and by the same token one busy shop does not mean the revival of all industry to normal activity. On the other hand, each busy plant brings business to other manufacturers who lie between it and the source of raw material. The forward movement of the endless chain of production is stimulated and we are all a little nearer to the "normalcy" of our hopes.

Is There a Good Landing Field in Your Town?

ALL who have followed the trend of the times are convinced that commercial aviation is on the way, and that it must be reckoned with in the next few years. As rapid transportation cannot fail to stimulate business activities in many lines, we should all encourage its development.

The first requisite for commercial flying, either spasmodic or regular, is a series of landing fields, covering all probable air routes. The Army and flying clubs all over the country are doing what they can toward this end. If we had the modern automobile with no place to run it except around the back yard the situation would be much like that of aerial transportation of today. Good roads made the automobile possible. Landing fields will do the same for the airplane.

Governor Hartness of Vermont, himself a licensed pilot, is urging his state to become a pioneer along this line. Each of us can do a little by arousing interest in the necessity for landing fields as an aid to the advance of aviation. No town or city without one or more landing fields will be on the map when air travel develops as it is bound to do.

Cut Production Costs With Modern Equipment

THERE is a hoary old story of the shiftless farmer whose house had a very leaky roof. When it was fair it didn't need fixing—and when it rained of course he couldn't fix it until it cleared up.

It's the same way with too many machine shops throughout the country. Their leaky roofs are in the shape of poor machine equipment. When demand is good buyers will pay a high price for their product, and they feel they do not need to put in new machinery.

But when business is slack and they feel they cannot buy—that is the time when their poor equipment counts most against them. They cannot meet competition and the business goes to those who have proper machinery for producing work at low cost.

These lame ducks always think that the successful bidder must be losing money at the prices he bids for work. They are very apt to call it cut-throat competition, when in reality it is simply foresight and good management in having up-to-date shop equipment.

In one recent case of this kind a contract was taken at what seemed a very low figure and the high bidder protested that it could not be made for the price asked. So the successful bidder showed his shop time on the job to be 48 hours, as against the other bidder's estimate of 155 hours. A comparison showed modern equipment in one plant—out-of-date machinery in the other.

Now is the time to look over your equipment with the same critical eye as though you were appraising a competitor; to ask yourself whether you can afford to let business go to the other shop because of its better equipment. Production costs must be brought down by the use of the best machinery possible.

The Only Way to Stimulate Business—Buy Now

MACHINE tools are indirectly behind all kinds of manufacture. It is because of this indirect connection that the machine-tool industry fluctuates with general business, but often at different periods.

As the demand for manufactured articles must precede the demand for more machine tools, the real problem is what will stimulate buying of machine products? There is only one answer—for each to buy what he needs and to buy it now!

We are talking of thrift campaigns—but few seem to realize that hoarding is not thrift. The kind of thrift that makes for better business is the kind that makes a man buy what he needs at a fair price, instead of waiting for bargains at panic prices.

Buying staple manufactured articles at a fair price, hastens the day when new machines will be needed for their production. Machine-tool orders will not and can not come first. Wearing shoes and clothes beyond your usual limit, making the old business or passenger car do another season, putting off that washing machine another year, all delay the return of demand for machine tools.

Unless some one buys, there can be no sales, no demand for more product, no reason for manufacturers buying new machinery. "George" will not do it all—we must do some of the buying ourselves.

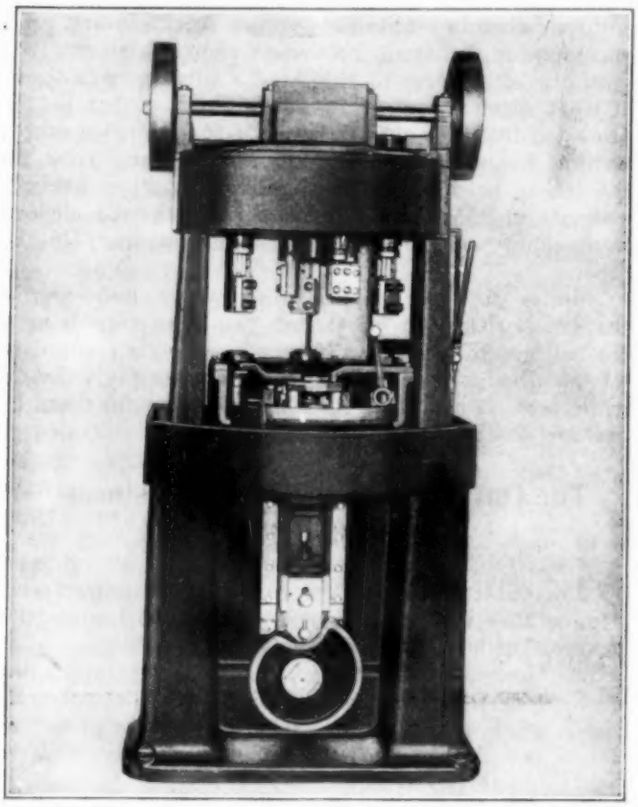
Let everyone who can, buy what is needed *now*—and business will pick up all along the line.

Shop Equipment News

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval. Brief descriptions appear later in Condensed Clipping Index in both American and European editions.

Manufacturers' Consulting Engineers Multiple-Spindle Vertical Boring Machine

The illustration shows a vertical-spindle boring machine recently developed by the Manufacturers' Consulting Engineers, McCarthy Bldg., Syracuse, N. Y. The machine is intended for production work, being



MULTIPLE-SPINDLE BORING MACHINE MADE BY THE MANUFACTURERS' CONSULTING ENGINEERS

adapted to the handling of a single part, such as a cylinder of an automobile engine or a connecting rod, the latter case being illustrated. If it is desired to machine different parts on the same machine, it is necessary to change the head of the machine, the rotary fixture and the cam.

The spindles rotate only and are fixed in a vertical position. The rotary fixture and the work are fed upward to the cutting tools. The cam feed makes it possible to obtain a very quick return and variable feed, so that when desired it is possible to finish the bottom of a hole. One idle position of the rotary fixture is allowed, so that the loading and unloading are done while the machine is working.

The machining time for producing an automotive connecting rod on the machine, rough boring, semi-finish boring and reaming both the large and small holes, is said to be 65 seconds. The large hole in this case is $1\frac{7}{8}$ in. in diameter and $1\frac{3}{4}$ in. long. A larger machine of this type will complete more than one rod per cycle, if desired. The machine equipped for boring cylinders is stated to rough bore, semi-finish bore and ream a $3\frac{1}{4}$-in. cylinder 9 in. deep in $1\frac{1}{2}$ minutes. If it is desired to finish the bottom of this bored hole, one cylinder is completed in 1 minute and 42 seconds.

Becker Planer-Type Milling Machine

The Becker Milling Machine Co., Hyde Park, Mass., has placed on the market a planer-type milling machine having a crossrail adjustable for height. The machine shown in the accompanying illustration has a horizontal spindle, although vertical-spindle machines can be furnished, two heads being placed on the rail if desired. The machine is built in sizes from 24 to 48 in. in width and in standard lengths up to 20 ft., the specifications given being for the machine illustrated.

The housings are of heavy box section, bolted and dowelled to the bed of the machine and tied together above with an arch of deep box section. The length of the bed is $1\frac{3}{4}$ times the working surface of the table, so that under the most severe conditions the table is well supported. The table feed is thrown out either by dogs clamped to the side of the table or by hand. The table is of box section said to be heavy enough to meet all strains due to clamping and milling.

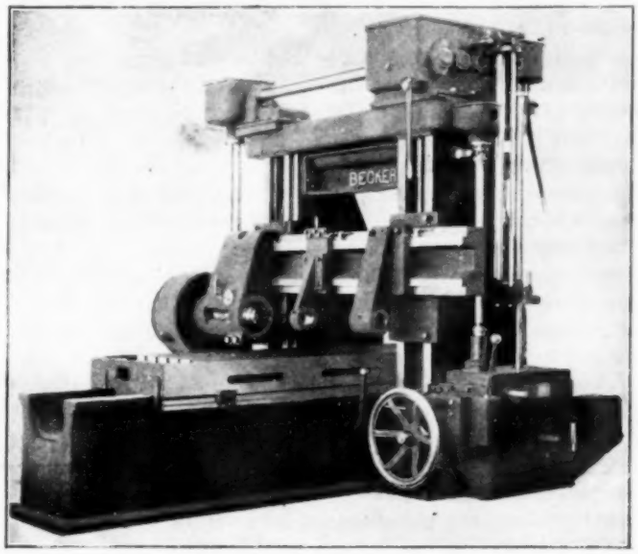
The machine is driven by a 20-hp. motor running at 1,200 r.p.m. and mounted, together with the speed box, on the upper beam above the arch. In the speed box are sliding gears giving eight changes of speed in geometrical progression. The gears are of forged steel and the necessary changes are controlled from below by means of hand levers. The gear box can be driven by means of a single 14 x 6-in. pulley. A clutch is furnished on the pulley for stopping and starting the machine, the lever for operating the clutch being located on the front of the machine. On direct motor drive, this eliminates the stopping and starting of the motor in order to stop the machine.

The longitudinal feed of the table is through a cast-iron rack and steel worm, which runs in an oil bath. The wormshaft is connected to the feed box, which is fastened to the lower side of the right-hand housing. In the feed box are the feed-change gears, the reverse gears and rail-elevating mechanism. It is stated that the sliding feed gears are so arranged that changes of feed can be made very readily while the machine is running, without injury to the gear teeth. In addition to the above feeds, the table is equipped with a power-driven rapid traverse.

The rail is of box section, is counterweighted, and can be securely clamped at any desired position on the

housings. It is elevated by power but has a hand adjustment through the feed box. A friction clutch is provided for the rail-elevating shaft to eliminate the danger of stripping the teeth of the gear trains, in case the operator fails to loosen the rail before attempting to lower or elevate the rail by power.

The heads, either horizontal or vertical, are mounted on the rail and are provided with power and hand traverse, the power traverse coming through a box on the end of the rail. Provision is also made for clamping the heads to the rail. The spindles are of crucible steel and run in phosphor-bronze boxes provided with means of compensating for wear. They are driven through a worm and worm gear running in oil. All gears are of steel and the bearings of bronze, all bearings being provided with sight-feed oil cups. The



BECKER PLANER-TYPE MILLING MACHINE WITH HORIZONTAL SPINDLE

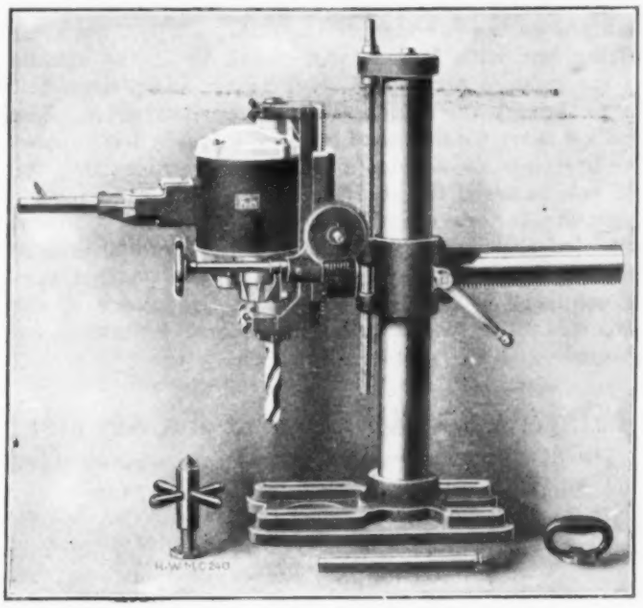
Specifications: Width between housings, 36 in. Bed 1¾ times the working length of table. Table feed; changes, 16; range, ¼ to 14 in. per minute. Quick traverse, 75 in. per minute. Maximum distance between top of table and under side of rail, 24 in. Spindle speeds; changes, 8; range, 12 to 78 r.p.m. Hole in spindle; taper, No. 13 B & S; through, 1⅛ in. Spindle largest diameter, 4¼ in. Spindle, hand adjustment, 6 in. Belt, width, 6 in. Driving pulley; diameter, 14 in.; speed, 550 r.p.m.

operating levers are on the operator's side of the machine, making control of the heads as centralized as possible.

Hisey-Wolf No. 3 Radial Drill Stand

The illustration shows a radial drill stand made by the Hisey-Wolf Machine Co., Cincinnati, Ohio, and intended for the holding of the portable electric drills made by the concern. The stand is known as the No. 3 and is made in two styles, the NN and the NNA. It holds a portable drill of either the single- or two-speed type and having a capacity of 1¼ in. Since the stand enables the use of the electric drill for precision work, it greatly increases the scope of usefulness of the tool.

The column is made of steel tubing. A horizontal adjustment of the head of about 12 in. is made by means of a rack and pinion, an operating radius of 20 in. in any direction being obtained. The vertical adjustment is made by means of a screw, about 20 in. of travel being provided. The feed motion of about 9 in. is controlled by means of a handwheel, while



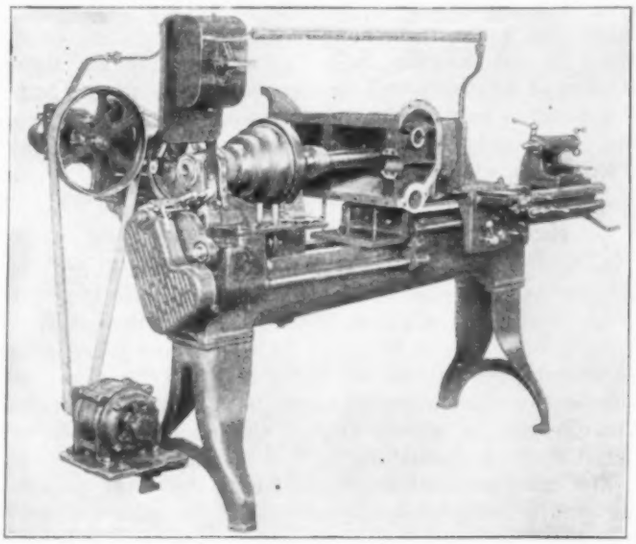
HISEY-WOLF NO. 3 RADIAL DRILL STAND

the quick return is effected by means of a crank. The handwheel and the worm may be operated in either the horizontal or vertical position, making the drill adaptable to use in places where the space is limited. The head, in which the drill is shown mounted, can be swung at any angle, a graduated dial being provided to enable quick setting.

The machine can be furnished to operate on either 110 or 220 volt current, either direct or alternating. Fitted with a portable drill carrying a motor, the dimensions boxed are 18 x 28 x 42 in., the net weight is 225 lb. and the shipping weight 300 lb.

Barnes Cylinder Reboring Attachment

The Barnes Drill Co., 814-830 Chestnut St., Rockford, Ill., has placed on the market a cylinder reboring attachment for use in connection with its sliding-extension gap lathe, as shown in the illustration. It is intended to accommodate any size or type of cylinder.

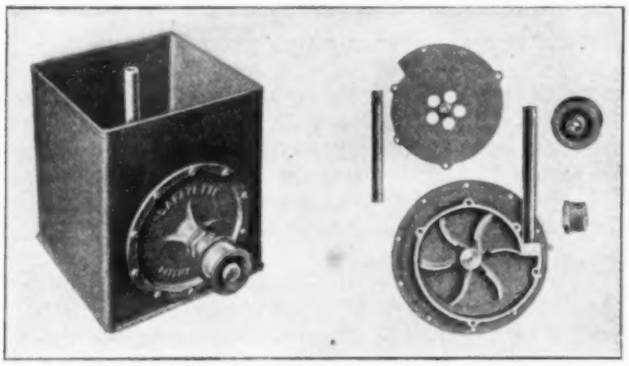


BARNES MOTOR-DRIVEN EXTENSION GAP LATHE WITH CYLINDER REBORING ATTACHMENT, SHOWING SET UP FOR FORDSON TRACTOR BLOCK

The attachment consists of an angle bracket to be clamped on the carriage of the lathe, a 2½-in. diameter boring bar with Morse taper shank to fit the spindle of the lathe, a high-speed steel cutter, and a draw-bolt to go through the spindle to assure positive drive. The bracket carries a hardened bushing to guide and support the boring-bar. A taper bushing which slides into the old hole to assist in centering the cylinder and supporting bolts for steadying the outer end of the cylinder, are also included. These bolts screw into an angle-shaped shoe which slides along the gap on the ways of the lathe bed. It is said that after setting up the job, less than five minutes is required to take a cut through a 4-in. cylinder.

Lafayette Soluble-Oil Pump and Agitator

The illustration shows the Lafayette soluble-oil pump and agitator recently placed on the market by the Fruchey Machine Co., 454 East Lafayette Ave., Detroit, Mich. The pump proper consists of a rotor on a ⅛-in.



LAFAYETTE SOLUBLE-OIL PUMP AND AGITATOR

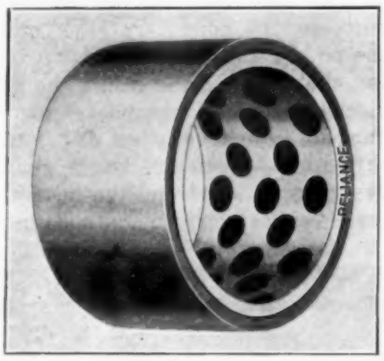
Specifications: Floor space, 12 x 16 in. Capacity of tank, 10 gal. Capacity of pump per minute at 1,000 r.p.m. at 6 ft. rise, 6 gal. Horsepower required, ⅓. Size of outlet pipe, ¾ in. Width of belt, 1¼ in. Shipping weight, 32 pounds.

shaft, running between two plates. The shaft is hardened and the inner end abuts a hardened steel button which acts as a thrust washer, the suction of the pump in operation tending to draw the rotor shaft against the button. The inlet is through five holes in the cover plate, and the outlet is through a vertical pipe. The pump is always charged with the oil or cutting fluid, which is said to eliminate loss of prime. The agitation is effected by the break in the veins next to the hub. The pump is self-lubricating, since all parts run in the oil. The tank, which can be furnished in any size desired, is made of 16-gage galvanized iron.

Reliance Self-Lubricating Bearing

A self-lubricating bearing has been placed on the market by the Reliance Machine and Specialty Co., 101 Green St., Jamaica Plain, Boston, Mass. The bearing is made both in a wide range of sizes, from those used on phonograph motors to those required for machine tools and in many different types, both radial and thrust. The illustration shows one of the standard types of radial bearing or bushing.

The bearing consists of two parts, the outside bushing usually being made of steel tubing. In case the bearing is apt to be subjected to severely corrosive conditions, the outer casing may be made of bronze, or it may be made of steel and tinned. The inner bushing is made of bronze, and is drilled with a number of ¼-in. holes, the holes being slightly larger on the outside than on the inside of the bushing, so that the lubricating mixture with which the holes are filled will be retained in them. In assembling the bearing, the outer casing is expanded by heating and then shrunk on the inner casing, after which the two are pinned together. Neither of the bushings is split. It is stated that the bearing is manufactured with fewer operations than ordinarily required on bearings for similar purposes. The holes in the inner casing are filled with a lubricant composed of pulverized lead and graphite, as well as other ingredients. It is stated that this lubricant is forced into the holes from the outside, under pressure, and cannot be jarred loose when the bearings are in transit. The lubricant is automatically supplied to the shaft, so that the friction is very greatly reduced, without the necessity of providing any lubricant from the outside. In order to replace the lubricant after it has been exhausted, the two bushings are separated.



RELIANCE SEF-LUBRICATING BEARING

The bearings can be furnished in any length or diameter required. The shaft holes are ordinarily made larger than the standard size of the shaft to which the bearing is fitted, so as to provide a running tolerance. The outside diameter of the bushing is ordinarily made slightly above the standard, so as to allow for a driving fit. The inner casing is made with a thickness of $\frac{3}{32}$ in. The outer casing can be made with any desired thickness, to suit the requirements. It is stated that the bearing has a very wide range of adaptability and that its life is very long.

Stuebing Steel-Bound Lift Truck Platform

The Stuebing Truck Co., 141 Fourth St., East, Cincinnati, Ohio, has recently developed the portable truck platform shown in the illustration. The platform is made of oak bound with angle steel, and supported by steel legs which are made with broad bearing surfaces,

STUEBING STEEL-BOUND LIFT-TRUCK PLATFORM

so as to eliminate the possibility of injuring floors. The bolts and nuts with which the platform is assembled bear on steel plates so as to save wear on the wood. This platform is made in sizes to suit the purchaser and can be furnished in box type, sectional bin type, stake type, table type, or other designs. The platform is said to possess strength and convenience of operation and to be adaptable to all types of lift-truck work.

The Machine Tool Shop in Time of Depression

Careful Survey of the Product, Its Market and Financial Resources Back of It Advisable—Value of a Good Budget—Better Times Ahead

By E. J. KEARNEY
President, Kearney & Trecker

IT IS OFTEN said that depressions have their advantages, for the reason that they eliminate competition by the application of the law of the survival of the fittest. A little careful thinking along this line will certainly lead us to a different conclusion, for in periods of inflation and overbuying a great many are tempted to enter the industry because of the easy money in sight at the time. It is doubtful if there is any advantage to the older and stronger concerns in a condition of business likely to cause this elimination. Is it not better for the industry as a whole for concerns that are in the business to remain in it, studying the conditions that are necessary for success, learning of its hardships and severe reactions, and preparing to take care of the legitimate demand when it comes, rather than have a new crop with each period of inflation? A study of the history and statistics of our industry will show that it is subject to very violent fluctuations. The product is purchased only as an addition to capital assets, and at the first sign of a general falling off of business, orders cease and unhappily cancellations of machines already ordered, take place, resulting in closing or partial closing of shops, followed by a considerable amount of unemployment.

If a young man starts out to select a trade to which he desires to be apprenticed, with the expectation of finishing at, say twenty, he would, if he were wise and had proper vocational guidance, make a survey of the industries before making his selection of the one he would adopt for a life work. In making this survey, he would take into account the prospect for continuous employment throughout the years of his working life, which might reasonably be expected to extend from, say, twenty to sixty, or forty years, as a journeyman, during which time he might reasonably hope to be continuously employed. In some industries like the building trades in our northern climate, he might not expect to be employed for more than two-thirds of the time, depending upon the climatic conditions in the city where he lived and the branch of the building trade to which he belonged and whether it involved inside or outside work, the wages on the whole adjusting themselves to the conditions of enforced idleness incident to the trade.

In the machine-tool industry, during his forty years of activity, he might reasonably look forward to several years of idle time—possibly as much as one-third. At present, those older employees in our factories, who form the main support of our organization—the men with whom we are loath to part are not working, on the average, more than two-thirds as many hours per week as they were a year ago; and even if their wages have not been reduced, their earnings are on a much lower basis.

The industry might be stabilized, if it were possible to run continuously over a long period of years on the basis of the average production, building up a sufficient amount of stock to take care of any boom, running the factory forty-eight hours a week, year in and year out, just as the pumping station might run continuously, filling the reservoir that would take care of the fluctuating demand for water. Such a program would require financing far beyond anything possible in connection with the machine-tool industry. It would require a very much larger margin of profit than is ordinarily enjoyed if machines were to be built and carried through several years, with the possibility of antiquation before sale, to say nothing of interest, taxes, storage, and care during that period. The margin of profit required for such a system is best illustrated by referring to the practice of certain dealers in buying second-hand machines at scrap prices in times of financial distress and carrying them over into a period of prosperity, when the demand for immediate delivery is such that unusual prices can be obtained.

Three Classes of Business

If we were to make a survey of the industry, we would find that the financial and general strength varies greatly, one concern with another. They might roughly be divided into three classes, understanding, of course, that no exact classification is possible as the entire scale would be covered. We have on one hand concerns with abundant liquid assets that are so well financed that they can hold their organizations together and continue to operate on a reduced basis through a protracted period of depression. Then, there is a second class, perfectly solvent, that are able to weather quite a long storm but which will run into difficulties if the period be greatly protracted. There is a third class at the lower end of the scale that with any prolongation of the period, unless its affairs are very carefully steered, must face insolvency. It is necessary, in times like the present, for every one to make a careful survey of his own business.

First, as to the nature of product. Is it of a more or less special character so that the marketing of it, if it were carried into stock, would be a question? Or, is it a more or less standardized product which has gone through a long period of development and is not likely to be faced with strong competition in the near future, in the way of improved design of such a character as to either greatly reduce the cost of the machines or enhance their productive capacity?

Second, there should be a survey of the stock on hand, the stock in the hands of dealers, and the condition of the shop inventory as regards the amount and kind of material on hand.

Third, the survey should take into account the kind of a sales program that is practiced. What arrangements have been made in the past for the continuity of sales? Some of the smaller and younger concerns, when they enter the market during periods of great activity, find that they can dispose of their entire product through one dealer willing to give them large orders—perhaps taking their entire outputs for re-sale in a comparatively restricted district. Naturally, their sales outlet will be much less over a protracted period of depression than it would be if they had a number of agents scattered over a wide territory, who were here and there picking up an order for them.

Fourth, and the most important, is a careful inventory of financial resources, which, after all, is the foundation of the whole structure. After having made a survey of one's business, such as I have just stated in brief outline, I believe it to be of first importance to lay down a definite program-chart, a course as it were, for the immediate future. The survey has taken into account the kinds and quantities of material on hand, the work in process, and the minimum purchases of material necessary to complete the machines under way, where such machines can be carried over into stock, sales being lacking. Where a shop builds various kinds and sizes of machines, a selection should be made of those machines that will give the most employment to labor with the least expenditure for material. While laying emphasis on a program that will involve the minimum expenditure for material, I am mindful of the fact that a great many companies purchase their castings from foundries that depend upon them for their existence and any complete cessation of the purchase of castings might possibly put the foundry out of business, which is a question that must be taken into account and given its proper value as to whether it is not advisable to give some support to the foundry on which you depend for your castings in times of prosperity.

Forecast the Future

In making up a program, it would seem to me to be the wise thing to look ahead to see what the probable market might be for a few months. No one, of course, knows how long this depression is going to last. We have different ideas as to the extent and nature of it and as to what constitutes "normal." If we were to use as a base line the growth of the machine-tool industry prior to 1915 and extend that line, it would come out this year—1921—at a point far below the boom period of the last six years.

Forecasting the future in this respect should be done conservatively, depending upon the financial strength of the one making up this program. Without expressing my own opinion, but merely restating what I have heard from many business men in this and other lines of industry, some of which are now recovering, there might be expected a slight improvement in the machine-tool market during the spring over the months of January, February, and March. Nothing very great, however; and for the succeeding months, until October, little better than the present. I am not putting this forth as a prophecy. I am merely repeating remarks that I have heard on the street and elsewhere.

Value of the Budget

I am a firm believer in the preparation of a budget as a proper course to be pursued in both domestic affairs and in the expenditure of the Government, and it is just as important for a business concern, especially at this time, when the outgo exceeds the income. Any banker will tell you that a great many business men do not make a proper survey of their business to ascertain what their probable financial needs will be. They live too much from day to day. Finding that bills are pressing, they require another ten thousand dollars. They go to the bank and get the ten, without sufficient knowledge as to what their next month's requirements are going to be —or the month after.

Every one of us must depend upon banks, and our chance of receiving the required accommodation is greatly enhanced when we can show that we have a definite program and know exactly when and how much money will be required during the few months just ahead. Take your banker fully into your confidence, and do not wait until you are pressed before doing so. He requires time for investigation and analysis of your affairs before coming to a decision.

I have prepared a simple budget, a hypothetical one, showing how this can be done in a simple way. This is prepared covering a six months' period, which may be too long or too short, depending upon the condition of your business and the character of the product.

BUDGET FOR SIX MONTHS ENDING SEPTEMBER 1, 1921

Cash on hand, March 1			$5,000.00
Liberty bonds to be sold (at market)			2,500.00
Add:			
Customers' accounts outstanding March 1		$25,000.00	
Estimated sales for March	12,000.00		
Estimated sales for April	20,000.00		
Estimated sales for May	20,000.00		
Estimated sales for June	15,000.00		
Estimated sales for July	10,000.00		
Estimated sales for August	10,000.00		
	$112,000.00		
Less: Customers' Accounts Outstanding September 1	20,000.00	92,000.00	
			$99,500.00
Deduct:			
Probable Disbursements:			
Accounts Payable March 1	$22,000.00		
Purchases for the period	46,000.00		
	$68,000.00		
Less: Accounts Payable September 1	20,000.00		
	$48,000.00		
Shop wages	$46,000.00		
Salaries	5,000.00		
Federal taxes	6,000.00		
Miscellaneous	8,000.00	65,000.00	113,000.00
Cash in bank, September 1		5,000.00	
			$118,000.00
Deficit to be met with bank loan			$18,500.00

This budget anticipates the carrying of a $5,000 balance in the bank at all times. On this point I wish to lay special emphasis, as some of our newer members may not know that their standing with the bank depends very largely on the maintenance of an adequate balance. Many banks are loaning money at the present time at the same rate of interest as that charged by the Federal Reserve Bank on re-discounts, so that no money whatever is made out of the loans except on the free balances that are left with them, which may be less reserves, loaned to someone else. If you want your bank to prize your account, make it worth while to them by carrying a balance equal to 10 or 20 per cent of your loan.

So much for the budget, in which I have great faith. The unknown factor is how much can be sold during the period and how soon we may expect something in the way of recovery. These are things which each and everyone must settle for himself. We certainly hope that it comes soon enough so that the weakest among us can stick it through.

We are citizens of a country, the richest in the world, with resources of all kinds at our command. We are slack not because we do not have the means to buy, but because we, as buyers, are frightened and all other buyers are of the same mind with us. It is possible in our desire to cut to the minimum, that we may be "penny wise and pound foolish." It is well to be conservative—but not too conservative, as after all, resumption depends upon confidence among ourselves as well as among those to whom we expect to sell our product.

Let us look at the future courageously, with faith in this great basic industry. Let it be a time for study of improved production methods, costs and other things necessary to give us a share in returning prosperity.

Business Conditions in England

Coal Situation Serious Due to Decrease in Exports—Further Cuts Noted in Automobile Prices—Some Small Tool Makers Busy

BY OUR LONDON CORRESPONDENT

HAVING by continued hammering helped to make an impression on the stiff defense offered by the Chancellor of the Exchequer against assaults on the excess profits duty, the Federation of British Industries, through the president, has recently addressed the British Prime Minister himself on the industrial condition of Great Britain, the purpose being to draw his attention "to the great dangers which confront British industry at the present moment." In fact assertion is made that "British industry is fighting for its life and the next twelve months may be the most critical in the economic history of this country." Coal being almost the basis of metal and other industries, to say nothing of exports, reference is naturally made to the coal situation, as to which daily conferences are being held for the purpose of arriving at a solution of the wage difficulty.

As to transport, the federation regards the burden as crushing. Nor are conditions improving here, for, despite the largely increased rates and fares, the railways are steadily losing money, though the loss will soon be mitigated by the fact that, owing to the decreasing cost of living as officially determined—the fall announced for last month was 10 points—wages of railway men will automatically come down by 4s. a week, this implying a saving to the companies of about seven and one-fifth million pounds a year.

The exchange position is one which the government cannot easily affect, except by providing as far as possible for the free interchange of goods between nations, and the new arrangement with Russia, whether it involves recognition of the present government or not, will be welcome—provided the passage of goods is not one-sided. The federation will therefore press for a reduction in the income tax as a means of lightening the present load, high taxation necessarily reducing savings and consequently the flow of capital to industry.

England Depends on Exports

Great Britain depends for her continued existence as an industrial country on her ability to export in exchange for food, the home food production being sufficient, it was recently stated, to keep the nation over the week-ends. Yet, eliminating for the moment our "invisible exports" by way of shipping services, etc., the value of exports during the working week has been steadily diminishing. The calculation has been made that, while in July of last year our imports amounted to about 6.1 million pounds worth per working day and our exports to 5.1 million pounds worth, by last month our imports had fallen to about 4 million pounds worth and our exports to 2.8 million pounds worth per working day, not merely because of the fall in prices, but also, in fact chiefly, on quantities. In quantities imported raw materials are at present not much more than half those of the pre-war period; indeed taking all imports, the weight seems to be about five-eighths.

A change appears to have come over the position regarding wages. Until recently the employing element has endeavored to obtain increased output with a view to the maintenance of present wage rates. Now a distinct move for wage reductions seems quite clear. Of course, with decrease in the officially estimated cost of living, numbers of workers automatically suffer reductions. As officially recorded, the decrease during February was £450,000 a week, applying to some 1½ million work-people. But with the decline in living costs the actual net value of the wage, even when the sum is reduced, should be kept about constant, while persons who have not suffered reduction have actually by the process of events received an increase in real wages. In engineering wages are stabilized—to use the latest "blessed word"—for a few weeks longer, that is for men. Lower rates for women and for boys have been agreed upon. Reductions are demanded in iron founding and similar claims are being put before the Industrial Council for a number of other industries.

Meanwhile, unemployment continues to increase. Leaving out of account youths of both sexes, according to the latest announcement 872,000 men and 335,000 women are registered as unemployed, with 708,000 men and women on short time. At the beginning of the current month considerably more than £1,000,000 a week was being paid out as unemployment benefit from the state insurance scheme, which covers 12,000,000 workers, men getting £1 a week and women 16s. The Minister of Labor has claimed that "provision on that scale has never been made in this or any other country before." The sums thus paid are of course outside trade union benefits. Unregistered unemployed are estimated by the hundred thousand. Nor is that all. Many firms are retaining their men to build up stocks which must almost inevitably be sold at a loss—when they are sold.

The decline in the engineering industry has not been stayed and short-time working extends in some instances to makers of textile machinery, while sugar machinery manufacturers, who also were well placed, are now finding new orders difficult to obtain. Reduced naval estimates carry with them further discharges of men from the dockyards.

The spring has been expected to bring with it some measure of return of prosperity to the motor trades and the hesitating purchaser has been helped by further declines in prices which have been announced almost daily—even by a firm who not long ago publicly announced doubt as to the need for this action. American imported cars are among those reduced; for instance, the price of the Maxwell four-passenger has just been dropped by about £100, and of the Chalmers Six by about £150. The well-known Vauxhall cars have been further reduced by £300 or so, this being the second cut of about the same amount in the present season. But so far the long-predicted crashes have been staved off.

On the machine-tool side the market for standard tools barely exists. Makers of some small tools are relatively well off; the call for gages and twist drills has not become any more insistent but the shops

engaged on milling cutters are at least moderately employed and some firms could even run overtime on orders for screwing tackle. The only machine tools that really occupy the energies of firms just now are the heavier and rather special orders.

The prospect of the Sheffield steel firms have naturally been the subject of rather anxious discussion and public statement has been made of the relief felt when the directors of Vickers, Ltd., gave notice declaring payment of the full dividends on both classes of preference shares and stock. Announcement has yet to be made regarding ordinary shares. As to Cammell, Laird & Co., both old and new ordinary shares will receive 7½ per cent, with £102,970 to go forward. Hadfields, Ltd., has been compelled to reduce the dividend, the profit last year amounting to £107,856, against £203,254 the year before. Here the total dividend is 5 per cent free of income tax, with £135,727 carried forward. Adjustments may yet be necessary in regard to taxes. The molders' strike is put forward as the reason for the decline in profits. The directors announce that, with a view to the development in the use of the Hadfield system of manufacture and the sale of its special products in the United States, the Hadfield-Penfield Steel Co., has been formed, in which the Sheffield firm halds a substantial interest. The British Aluminum Co., after making provision for excess profits duty and corporation tax, shows profits amounting to £428,157 against £348,108 the previous year. Although last year was so successful, a decline was seen in the autumn and since then output has been seriously curtailed.

The last report from the London Iron and Steel Exchange records mostly unrelieved depression. Several more furnaces have been blown out and the pig-iron section is described as in a rather worse position. Reductions in the prices of steel billets have been mentioned, but throughout forward buying is rare. Discouragement has resulted from the news that "a Glasgow concern had placed an order in Belgium for 10,000 tons of steel rails at a price £7 below that quoted by English and Scotch makers." Apparently during last week 20,000 tons of pig iron and between 10,000 and 15,000 tons of manufactured material was delivered into Scotland from the European continent.

Readers of these columns will be interested to learn that the European edition of the *American Machinist* is just completing twenty-one years of existence.

The Present Position of Austrian Industry

Financial Condition Almost Hopeless—Machinery Building Plants Doing Better But Still Below Normal—Commercial Penetration by the German Combines Increasing

BY OUR BERLIN CORRESPONDENT

AFTER the Austrian Empire fell to pieces the political leaders of German Austria got up and proclaimed that the country could not live as an independent state. This verdict was possibly the worst advice that those men could have rendered their country. The atmosphere of hopelessness it created brought the economic machinery to an almost complete standstill and developed a particularly bitter labor movement. For more than a year Austria has been on the brink of Bolshevism, and would no doubt have submitted to it, if the population were not so averse by nature to all extremes and violence. Politically the critical stage may be said to be past, but economically the country is still in a very precarious position. The war, and the upheaval following it, left stronger marks on Austria than on Germany, and her labor situation is far less settled.

Much time, and a considerable portion of the national wealth left to Austria, have been wasted in the post-war years while waiting for political developments. If they had been applied to reconstruction the country would now find herself in a better position.

Whether Austria really cannot live independently will be seen in the future. Hers will be a hard task, too hard perhaps for her strength, but that it is not quite hopeless is demonstrated by the improvements, which set in toward the middle of last year, and which are now becoming more and more marked. Almost all branches of industry share in this improvement, foremost among them the mining, iron and steel, electrical and machine-building industries.

The highly developed iron and steel industry of Austria, formerly in such a prosperous state, but during the months following the end of the war almost at a complete standstill, is now slowly recovering. The production of pig iron almost doubled last year, as compared with 1919, but has only reached 15 per cent of the production of 1916. The output of steel increased slightly in 1920, compared with the preceding year, and amounted to one-fourth of the output of 1916. The output of rolled products was 16 per cent higher than in 1919, and 27½ per cent of the production of 1916.

The Alpine Montangesellschaft, the largest iron and steel producer of Austria, had lately to blow out two of its six openhearth furnaces, on account of the lack of scrap iron. The employment of the iron works is also greatly hampered by the limited supplies of coal. Apart from that a considerable portion of the Austrian pig-iron production has to be sent to Czecho-Slovakia in exchange for coal. The high-grade steel works, like Böhler, Phönix and Ternitz, are in a more favorable position, as they receive a better supply from the increasing output of the local collieries. Those works have, since the beginning of last year, enjoyed a brisk demand for high-grade steel. The price of this steel has now nearly reached the world market parity. Most of the openhearth works and foundries are shut down on account of lack of raw material and coal. Of the seven blast-furnaces in Styria only two are working at fullest capacity, in spite of the extensive use of charcoal.

The keen competition of the German iron and steel industry, which is making itself felt, has brought into relief the absence of an organization of the Austrian iron and steel industry. The Austrian Eisenkartell, the Syndicate of the iron masters of the Austrian Empire, came to an end with the latter. It is no mere coincidence that not only in Austria but also in the other

states formed upon the territory of the erstwhile Austrian Empire, the old Eisenkartell is evoking desires for its resurrection in some shape.

Negotiations have been commenced between the iron and steel works of Austria, Czecho-Slovakia, Hungary and Roumania, with the object of coming to an agreement on all interests in common. It is quite possible that these negotiations will ultimately result in the formation of a trust, combining the iron and steel interests of the countries mentioned.

If this project is realized, Austria's industry will greatly benefit by it, as it is one of the chief objects of the intended combine to raise the Austrian iron and steel production, which used to be the chief source of supply for the former Empire, to its full capacity.

The situation of the factories representing the higher stages of production, mainly machine-building factories, is much better than it was a year ago when the general opinion of the future of this industry was very gloomy. Austria has now no less than 478 machine-building and kindred factories, not counting the small shops with less than fifty workmen, the number of which is far higher. These factories represent, in the aggregate, the machine-building and metal-working industry of the old empire, with the exception of Bohemia, whose production is, however, more of the heavy type, and the much smaller industry situated in Budapest.

The home market of the Austrian industry used to be a state of 50 million inhabitants, which has dwindled down to a country of 6 million inhabitants. The factories are, as a rule, very well equipped with high-grade German and American machine tools. The equipment is, indeed, frequently far superior to that of German factories of the same size and character. Notwithstanding this fact, the Austrian machine building industry was never able to compete with that of Germany in the export business. This may be ascribed to lack of enterprise more than to any other reason.

The collapse of the old empire and the formation of new states on its territory, which shut themselves off from the present Austria, deprived the latter's industry of its best markets. In the course of time, old connections have, however, been resumed, especially as the new states found it impossible to make themselves independent of their former sources of supply. This resumption of trade is becoming more and more marked, and is at present keeping the Austrian industry fairly busy. The position of the industry in those markets is now, however, quite changed. They have become export markets, and the Austrian industry can sustain its position in them only so long as it is able to compete with foreign rivals. The badly deteriorated exchange has so far permitted the industry to do this, but wages are moving up continuously and it is feared that the Austrian industry will be superseded by that of other countries, mainly Germany.

A number of the foremost firms, realizing this danger, are directing all efforts toward building up a real export business, on the strength of economical quantity production. The Austrian Arms Manufacturing Co. (Oesterreichische Waffenfabrik), for instance, has taken up the manufacture of motor cars on a large scale, and is now producing a car of excellent quality and at a moderate price. The country contains no less than five large motor car companies, which are equipped exceedingly well, and are doing their utmost to get abreast of their German competitors.

Factories making mining machinery are well employed on conveying and hoisting plant, for home and foreign orders, as the increase of the coal production requires new installations. There is, however, little demand for iron and steel works equipment. The Austrian locomotive works, completed, in 1920, 211 locomotives and 173 tenders, as against 144 and 97 respectively in the preceding year. Railroad car factories are mostly employed with repair work.

The present employment of the Austrian machine building industry, although quite satisfactory, judged by the very gloomy expectations of a short time back, does not nearly come up to its full capacity. As in any country that has been at war, it increased considerably during the war, and even under normal conditions there would have been difficulty in providing work for the extensions that have come into being.

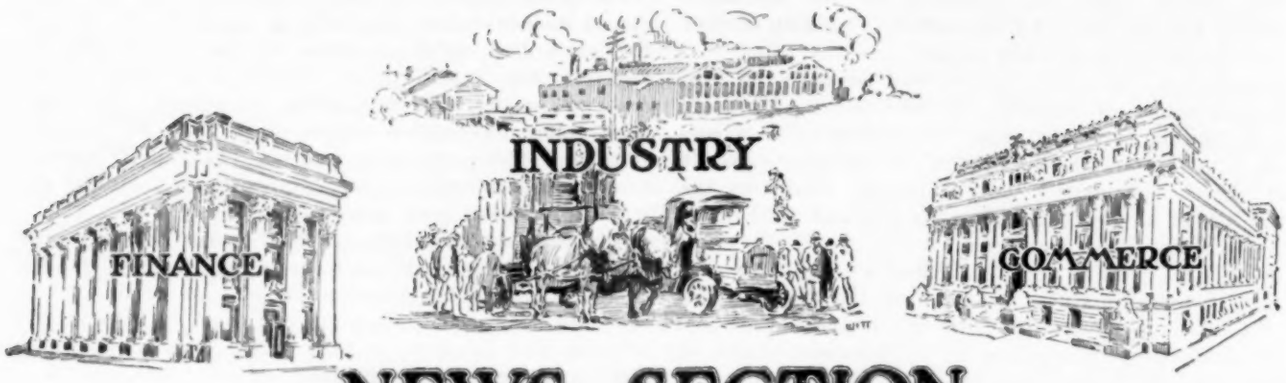
The difficulties have been particularly great in the case of the state works, engaged in the manufacture of arms and ammunition, which in the course of the war grew quite out of proportion to the reduced size of the country. There are five such plants, two of which are very much larger than any private manufacturing plant in the country. The larger of these, Wöllersdorf, has a floor space of 300,000 sq.yd., and the other, the Arsenal at Vienna, is not much less. These plants have been kept going only on account of the workmen, and by their influence. Even their greatly reduced operations require a state subsidy, which for the present year is estimated at 80 million crowns, but is expected to be considerably larger. These works are excellently equipped with modern machinery, and they have a very large stock of raw material at their disposal.

Like the German state works, they are drifting along without any commercial aim or business-like management, apparently for the reason only that they exist and have to provide work. The Austrian government is fully cognizant that the works are a dead load on the country's strained finances, and that no improvement can be expected as long as they are run as state works. It is intended to organize them as companies, in which the state will be a shareholder, or to turn them entirely into private enterprises.

The hopeful outlook which the increased activity of the industry affords, is counteracted by the country's desperate state of finances. The fact that a country of six million inhabitants has a deficit of 42,000 million crowns in one year needs no comment.

German business men have made the country's natural resources an object of closest study, and in their opinion they would, if properly developed, become a valuable addition to Germany's productive powers. Hence the interest exhibited not only for the state works, but in a much larger degree for the country's mineral and water power resources. The Stinnes combine has already acquired the chief interest in the high-grade steel works of Böhler & Co., is now negotiating for a controlling interest in the largest Austrian mining and steel producing company, the Alpine Montangesellschaft, and in fact is trying to buy up every promising property that can be bought.

Other industrials of smaller size have followed the lead of the Stinnes combine. So far, the Austrian federal governments, which are decisive factors in the sale of natural resources, and private owners are resisting such offers. Nevertheless, the penetration of Austria by German industrial interests, in anticipation of political changes, is on the way.



NEWS SECTION

American Textile Machinery Co. To Enter European Markets

The Crompton & Knowles Loom Works of Worcester, the Whitin Machine Works of Whitinsville and the Draper Co. of Hopedale, the three great textile machinery builders of Worcester county, Mass., own three-fifths of the stock of the American Textile Machinery Co., which has been established to market in European countries the machinery built by the stockholders. The other stockholders are the Saco-Lowell Co., textile machinery, and Lockwood, Greene & Co. of Boston, mill engineers.

The American Textile Machinery Co. has established headquarters in Paris, and branch offices in Italy, Spain, Portugal, Norway and Sweden. Already some machinery has been sold, but in common with everyone else handling American goods in Europe the serious handicap exists of credits and the rate of exchange. However, the company's officials believe that the matter of European exchange and credits is being arranged satisfactorily, and that the sale of American textile machinery through the agency of the company will soon be placed on a very substantial basis.

PERSONNEL OF THE COMBINE

The president of the company is Chester S. Allen, a former Worcester man. The first vice-president is W. L. Nicoll of Paris, the second vice-president is Frank J. Hales of Boston and the treasurer Charles L. Talbot of Boston. The directors include Irving H. Verry, vice-president of the Crompton & Knowles Loom Works; E. Kent Swift and Lawrence M. Keeler of the Whitin Machine Works, Whitinsville, and Bristow H. B. Draper of Hopedale.

Belgian Export Trade Gain

During 1919 the monthly export trade of Belgium rose from only 1,000,000 francs in January to 353,711,000 in October.

During 1920 the lowest monthly figure was 147,542,000 francs in January, from which the monthly shipments rose to 842,665,000 in June, falling off slightly during the subsequent months.

Middle-West Factories Resume Operations

The Minneapolis Steel and Machinery Co., manufacturer of Twin City tractors and structural iron, reopened its foundry last week and will inaugurate an intensive three-months tractor manufacturing program.

George M. Gillette, president, said business is much improved. The company has an order for every tractor to be made. The demand for tractors in the Central and South Central States is good, he said. The company recently shipped tractors to Venezuela and Czecho-Slovakia.

The Shaw Enocks Co. has such a demand for tractors for road maintenance work that the plant is operating night and day.

The Minneapolis Traffic Association reports marked improvement in the business situation, as evidenced by increased railroad tonnage here and at other points nearby.

The Minneapolis assembling plant of Ford Motor Co., employing 700 persons, recently resumed. C. C. Hildebrand, manager, said that there has been quite an improvement in the situation in the country.

N. M. T. A. May Re-elect Newton

Albert E. Newton of the Hobbs Manufacturing Co. has been named for re-election as president by the nominating committee of the National Metal Trades Association. The election of officers will be held at the annual meeting at Hotel Astor, New York, April 20 and 21.

Other officers nominated are: First vice-president, George O. Rockwood, Rockwood Manufacturing Co., Indianapolis; second vice-president, W. W. Coleman, Bucyrus Co., South Milwaukee, Wis.; treasurer, F. C. Caldwell, H. W. Caldwell & Son, Chicago; counsellors, for two years, L. J. Chandler, Chandler Co., Springfield, Mass.; A. C. Gilbert, A. C. Gilbert Co., New Haven, Conn.; G. W. Mixter, Pierce-Arrow Motor Car Co., Buffalo; Paul C. De Wolfe, Brown & Sharpe Manufacturing Co., Providence, R. I.; Paul T. Norton, Case Crane and Engineering Co., Columbus, Ohio.

Triple Convention of Machinery Associations at Atlantic City

The big combined convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers Association will be held at Atlantic City, N. J., on May 16 to 18 inclusive, with headquarters in the Marlborough-Blenheim Hotel. The business program for the entire convention has not yet been completed but several of the sessions have been arranged and speakers have been selected.

On the afternoon of the first day, the sixteenth, there will be a triple session. Three speakers will be heard as follows: "Motor Truck Transportation," by S. N. Thompson, of the White Co., Cleveland, Ohio; "Business Conditions," by M. W. Mix, of the Dodge Manufacturing Co., Mishawaka, Ind.; "General Southern Conditions," by W. P. Simpson, of C. T. Patterson Co., Ltd., New Orleans, La. On the other days of the convention each association will hold separate sessions, taking up its own particular problems.

A feature of the closing of the convention will be a combined "Au Revoir" meeting on Wednesday at which the newly elected officers will be presented.

The evenings of the convention days will be taken up with vaudeville shows, dancing and a grand ball at the Marlborough-Blenheim on Tuesday night.

W. C. Peterson to Supervise Atlas Metallurgy

The Atlas Crucible Steel Co., of Dunkirk, N. Y., announces that W. C. Peterson, who for the past twelve years was associated with the Packard Motor Car Co., has been placed in charge of the metallurgical department of the Atlas Crucible Steel Co.'s mill at Dunkirk. During Mr. Peterson's term of service with the Packard company he has been in charge of the metallurgical laboratories, heat-treating departments and research work and he has resigned this important position to take up similar work at the Atlas. Mr. Peterson's work will include standardization of chrome-molybdenum products.

Business Conditions as the Big Banks of the Country See Them

Peoples National Bank of Pittsburgh Sees No Revival of Trade—Railroad Situation Worse—Foreign Politics Unsettled

At the opening of the second quarter of 1921 predictions made three months ago remain to be filled. Trade revival has not occurred; on the contrary, the volume of business has steadily contracted. Here and there improvement is noted, but it has been in those lines which anticipated by three to five months the general reactionary movement—as in textiles, rubber, and motor car construction—which set in last year. The change in the money market has been less pronounced than expected. The percentage of bank reserves is higher due to gradual liquidation of long-standing credits, but more than usual conservation is being observed in extending fresh credits where borrowers have been slow in adjusting their affairs to existing conditions. Some industrial corporations have become ultra-conservative in setting up reserves against possible eventualities of the future, and the disposition is becoming a little more general to set ahead the date for a positive revival in trade as a whole.

The Steel Trade

Contraction in the steel trade is more pronounced, and the Pittsburgh district has gradually lost ground, although it is perhaps still more fortunate than some other industrial sections. Prices have further receded, but the movement is much slower now than earlier in the year. As this review is being written, the Steel Corporation continues to adhere to 1920 quotations on basic products, but its official tonnage figures tend to confirm unofficial reports that new business is rapidly shrinking. The latest available figures on unfilled orders show that the total on its books was about 6,933,000 tons on March 1. The report due on April 10 will probably show that this total is down to or below 6,500,000 tons which would compare with 8,148,000 tons at the beginning of the year and with 9,982,000 tons at the corresponding date in 1920. The showing, however, would still be better than in the second quarter in 1919 when the business booked fell to 4,282,000 tons on May 30. That was the period when the trade was halting to learn whether or not pre-war prices were to be immediately re-established.

The price policy of the chief producer at that time was fully endorsed by subsequent events, in view of which its reiterated policy of the past four months appears to be fully justified. Today's average price in the open market is roughly $4 a ton lower than it was two months ago, and fully $16 a ton lower than a year ago, while Steel Corporation prices are said to remain virtually the same as two years ago.

From all appearances price concessions have not attracted any appreciable increase in new business. On the contrary, pig iron output is at the lowest rate in several years, and steel ingot output is about 23 per cent below the monthly average for the full year of 1920. Toward the end of March, the price movement became nearly stationary.

The decline in foreign steel markets last month was really precipitous, and yet the latest figures on British exports show a decrease from the average of 1920, probably due to German and Belgian competition.

Railroad Situation Worse

The railroad situation went from bad to worse during the month just closed. It finally reached a stage where heroic methods were adopted to reduce operating expenses. The decrease in gross earnings was reflected in the large addition to the number of idle cars, due to the falling off in freights, particularly of fuel and of the raw materials which enter into steel making, but extending also to most other industries and to products of farm and forest. The effect upon operating income was even worse, because overhead charges remain virtually unchanged. The latest available figures show that after providing for operating expenses, fixed rentals and taxes, rail transportation was conducted at an actual loss on many of the largest systems. These conditions were not confined to any particular zone, but were quite general throughout the country.

Financial Retrenchment

The first recourse was to retrench in all improvements involving new capital; the second, to curtail purchases of supplies except for the most pressing needs; the third, to cut down operating forces; the fourth, to dispense with clerical help wherever possible; the fifth, to reduce forces in the engineering departments engaged in planning for the future, and the sixth, to reducing wages of labor not embraced in the "National Agreement" negotiated last year. In a few instances, announcement of proposed cuts in wages of organized labor was made, anticipating a favorable outcome to an appeal taken to the Railroad Labor Board to suspend or amend the award made last year. This appeal failing, the orders issued to reduce wages of labor under last year's agreement were rescinded.

Being blocked in an attempt to take a short cut in readjusting labor costs to post-war conditions, some of the roads have announced conferences to be held this month between employers and representatives of organized labor to obtain voluntary consent to a reduction in labor costs. In one instance where this method was adopted last month, the proposed reduction was rejected by the men and appeal was taken by the roads to the Railroad Labor Board. Of course, it is possible for scores of such appeals to be made, and if each were considered separately and in turn, months would elapse before a decision could be reached in the last appeal filed. The consequence would be a multiplicity of varying costs in the same general territory, which would make for confusion to shippers, for dissatisfaction on the part of labor, and possibly for irretrievable financial loss to the operating companies. The hope is to have the appeals consolidated into one in order to reach a decision as speedily as possible.

Foreign Political Situation

Some interesting developments appeared in the foreign situation in the month just closed. We have space to refer only to two of the most important. The first was the failure of the German Government to comply with the demands of the Reparations Commission for the deposit in bank of the equivalent of $250,000,000 gold to the credit of the Allies. Germany was given the option of making the deposit in London, Paris or New York. It made neither selection nor deposit. Its non-compliance was followed by disturbances in the chief industrial centers of Germany, but these did not reach the proportions of a revolutionary movement.

U. S. Declines Russian Trade

The second event of interest was the signing of an agreement restoring trade relations between Great Britain and Russia. The politico-economic effect of this action cannot be fully appraised at this time, but it may easily deflect some existing international trade currents. Within less than two weeks after the signing of this agreement the U. S. Government denied application by the Soviet Government for the opening of negotiations looking to the restoration of similar relations between the United States and Russia. Early in the war, when the Imperial Russian Government was in the market for external loans, the Russian Empire was described as an inexhaustible reservoir of undeveloped raw materials. Great Britain and Germany have much greater need for such materials than has the United States. What the effect of the resumption of trade relations will be upon the demand for American raw materials remains to be seen.

David Forgan, of National City Bank of Chicago, Offers Intelligent Analysis of Present Industrial Situation

The present industrial situation is the worst that this country has experienced in many years. The so-called panics of 1893 and 1907 were not so disastrous because the reversal was neither so severe nor so sudden. This time we fell from the heights of seeming prosperity to the depths of depression—almost over-night. The wave of great volume, high prices and unprecedented profits broke, and we were confronted with an industrial panic in which buying almost ceased, cancellations of former orders were numerous, prices melted, and profits gave place to losses. In the last few months of 1920 many business concerns not only lost the profits of many preceding months, but in some cases of many preceding years. This was due to the fact that while all expected a reversal some time, most men were too close to their own business, too pressed with unfilled orders, and too burdened with the difficulty of procuring their raw materials to be able to sense the hour of the approaching change. As a rule, therefore, they were caught with heavy inventories to be written down, and correspondingly heavy indebtedness to be arranged with their bankers. Followed the passing of dividends, the cutting of overhead expense, the cessation of unfinished new building, the discharging of employees—all of which were necessary to the life of the particular business, but harmful to the general situation by curtailing the general buying power.

In former periods of depression we could sell largely to Europe and lean on her for financial support, but now Europe hangs like a millstone about our necks—owing us billions on which she is as yet unable to pay the interest, and prevented from buying freely from us by her post-war political confusion, her financial inflation, and the consequent break-down of her exchanges.

Who Is to Blame?

In a discussion of this kind the facts must be faced. Naturally, the man on the street asks how such facts are possible in the richest country in the world, and who is to blame. If he reads a labor paper he will be told that the whole thing is a conspiracy on the part of capital—and particularly "Wall Street" to break the unions. If he reads the magazine articles of some professor of political economy, he will be told that the banks—and particularly the Federal Reserve Board—are to blame for allowing such expansion of credit and currency that prices soared and the inevitable crash followed. If "Wall Street" is to blame it must have used its supposed power as Samson used his—not only to destroy his enemies but himself—for if anyone is walking the floor these nights it is "Wall Street" where all the business troubles of this country come to a head; and if the bankers are to blame, they now find themselves partners in numerous enterprises the condition of which gives them grave concern. The truth is that no one was to blame. Parallel conditions exist in all countries. We, and all the so-called civilized world have been and are in the grip of economic forces too strong for any class, any monetary power or any government to avoid. The expansion of credit, the high prices for labor and for goods, the fictitious prosperity and the resulting industrial crash were the inevitable and unavoidable aftermath of the costliest war in history. They are all explicable by and attributable to the working of the law of supply and demand.

What of the Future?

No conservative banker will commit himself to very definite prophecy at the present time. This, however, may be safely said, that the crisis has been passed, that the worst is over, and that recovery, although slow, has begun and will be sure. If the new Administration at Washington disposes of our chief problems wisely, I see no reason why the present year should not witness a return to fairly normal business. Revision of Federal Taxation, the Tariff, and Railroad Freights are fundamental. They are too complicated to discuss here, but they must be studied and settled scientifically—not politically.

In many lines, particularly those which were first hit, and hardest hit, orders for goods are now quite numerous. They are still small, and represent a hand-to-mouth policy on the part of the buyers, but urgency of shipment is a very noticeable and encouraging feature of these orders.

At such a time as this there are always pessimists who cannot see what is ever going to happen to cause a recovery, but in a long experience I have never found that the pessimists were right. I have great faith in the recuperative powers of the United States of America, and in the consumptive demands of one hundred and seven millions of Americans.

Determination is Lacking

Psychology plays an important part in all human affairs. If our people once make up their minds that recovery has set in, its progress may gather a momentum that now seems impossible.

Liquidation both in materials and wages must be well balanced. Some retailers are still trying to get war prices, and some laborers are still threatening strikes for the maintenance of war-time wages. These will have to yield. Generally speaking, however, business men have taken their medicine, and laboring men have shown a reasonable disposition. If all of this results in a reduction of the high cost of living, and a return to saner business ideas the present hard experiences will not have been an unmixed evil.

German and Italian Activities

Special Correspondence

A report from Madrid is to the effect that the Spanish Railway Admininstration has placed an order in Germany for 119 heavy locomotives. The German Locomotive Works promised to deliver the engines within a period of eight months, while the most favorable British offer was for delivery in ten months. In addition, the German Government has declared its willingness to pay an indemnity in case the German firm should not deliver the engines in the time agreed upon. Furthermore, the German house has agreed to accept payment in German marks or Spanish pesetas. The locomotives have to be paid for after they have been in service for a period of six months and after the Spanish Railway Administration has declared same to be absolutely satisfactory. Easy terms, indeed!

Italian Capital for Rumanian Industries

With the assistance of some of the leading Italian banking institutions a company styled "Sindacato Industriale Danubiano" has been formed at Milan for the purpose of developing the metal industries in Rumania. In connection herewith it may be stated that the Rumanian market should offer a good field for American machine tools of all kinds. The machines at present in use are mostly old and worn out.

The Italian Government is seriously considering the construction of a fourth Alpine tunnel. The most favored project is that of piercing the Splügen chain of mountains at a cost of about 700 million francs.

The Zeppelin Works of Today

The extensive establishments of the German Zeppelin Works at Friedichshafen on the lake of Constanz (Bodensee), not far from the Swiss frontier, where during the war tremendous airships were built, have now undergone, like the Krupp works, considerable changes and reconstructions. Instead of heavily armed airships the works are now turning out all kinds of peace material. A large number of skilled mechanics and workmen, especially trained in the construction of airship material, had to be discharged. Large quantities of special machines and apparatus especially designed and built to suit the former work, had to be disposed of at considerable loss to the company. It will be remembered that the construction of airships, on account of the Versailles treaty, remains forbidden for a long time, and in spite of successful negotiations which have been carried on with the Argentine Republic, Chile, Sweden and some other countries with a view of building airships for those States there is very little hope that the works will be allowed to build airships again in the near future. For this reason the administration had to reorganize the entire plants of the company.

Siam a Ready Market for American Machinery

According to a statement issued by vice-consul Carl C. Hanson there appears to be no machinery manufactured in Siam. The volume of such imports from abroad has hitherto been comparatively small, owing to the fact that the Kingdom's manufacturing interests remain as yet undeveloped. Considerable quantities of modern mining machinery has, however, been in use in Siamese Malaya, notably tin dredges, many of which have been supplied by well-known American firms. These firms have also furnished similar machinery for excavating canals for Siam's extensive irrigation scheme which is now under construction.

In view of the latter scheme, which is expected to bring extensive, more or less dry, areas under cultivation, and part of which may be completed during 1921, it is expected that a fairly large number of tractors and other agricultural machinery will be needed very soon. In fact, experimental work has already been successfully done in the use of several well-known American tractors. Demonstration by capable engineers is essential in the beginning, and there are now in Siam two experienced American engineers who may possibly undertake the work.

Of marine motors the small American outboard type has become very popular, and owing to the fact that some 400,000 small boats are registered as in use in Bangkok alone there is likely to be a demand for these.

Owing to the partial failure of Siam's rice crop for the 1918-19 season there has been but little activity in the imports of rice-milling machinery during the last two years, but prior to the war Germany did an extensive and sole business in this class of machinery. However, the prospects for a fair rice crop for the current 1920-21 season are good, and therefore a normal demand for this machinery seems possible.

The demand for textile machinery has hitherto been insignificant. Cotton goods or other textile fabrics and yarns are not manufactured in Siam, but some weaving is done on native and Chinese looms.

Hugo Stinnes To Build R.R. Equipment for Soviet

According to an article in the *Golos Rossij*, the official Russian organ published at Berlin, the well known German iron master Hugo Stinnes is negotiating with the Soviet government with a view to acquiring the large Briansk steel and machinery works. It is stated that Stinnes promised the Soviet government that as soon as he had taken possession of the Briansk works the works would turn out 70 locomotives during the first year, 200 in the second and 1,200 in the third year and that the production would finally reach 8,000 locomotives and 80,000 freight cars per year. One-third of the net earnings would be turned over to the Soviet government, the report adds.

The End of the German Steel Trust

The Stahlwerksverband, which is the official title of the German Steel Trust, one of the mightiest and most influential institutions of pre-war Germany, has just delivered its death-song in the shape of a business report covering the time between July, 1919, and June, 1920, at which date the business activity of the corporation came to an end.

The beginning of the dissolution of the trust dates back into the early stages of the war, when the powerful structure commenced tottering on account of the steadily growing tendency of its members to free themselves from all restrictions with regard to production and distribution. The enormous demand for steel products during the war caused the steel trust to be more and more considered as something entirely superfluous and a severe handicap to individual progress. It would have fallen to pieces before the War came to an end if the government had not brought influence to bear upon the steel works for the sake of the continuation of the trust. Conditions, however, became critical after the separation of the Luxembourg and Lorraine Works and great difficulty was found in patching up matters from April, 1919, to the end of September, 1919. When, however, at the end of July the Sarre works also left the trust, all hope for its continuation was abandoned. The government conceived the idea of a new body which was to take over the functions of the steel trust, under the control of the government, as far as distribution and the control of prices was concerned.

This body, the Eisenwirtschaftsbund, or Iron Economy Society, came into existence in April, 1920. Strong pressure was used by the government to keep the steel trust alive until operations of the new society came into swing. The corporation agreement was compulsorily renewed four times, until the third of June, 1920, when its activities were terminated definitely.

The last business report of the trust makes sad reading, and is conspicuous for the absence of optimism. It deals very severely with the official institutions for the control of the export, the export licenses, and the slow, red-tape, business procedure for obtaining them, which were patiently borne by the foreign buyers only so long as the foreign markets stood in great need of German steel products. Many substantial orders at good prices were lost while the export offices could not prevent large quantities of steel, especially rolled products, which were bought at inland prices obviously for inland consumption, from finding their way across the frontiers through the "Hole in the West," which is the common term used for the occupied territories, where control of exports is handled indifferently and very leniently. In this way, only 11 per cent of the total shipments of 1,278,310 tons could be sold abroad. Even the strong inland demand of that period is not looked upon as a hopeful sign, as it was discovered to be artificial and inflated by speculation.

After delivering a parting shot at the steel trust's successor, the Eisenwirtschaftsbund, which it is said, in the opinion of the steel industry is perfectly superfluous and out of place, the report gives vent to rather pessimistic views on the present situation and on the outlook, which is declared to be very gloomy. The main danger to the German industry is seen in the growing competition of foreign rivals, whose situation is steadily improving, while the German industry has not seen its worst time yet. The latter is existing solely on the grace of the low exchange, and is thus controlled by a factor which in itself is uncontrollable. A sudden rise of the exchange, like last year's, would land the German steel industry in a sorry predicament.

The shipment of semi-finished products was 314,762 tons, as against 439,309 tons in the previous year, or 124,547 tons less. Of these shipments, only 12,234 tons, or 3.89 per cent, were sold on foreign order. The shipment of railroad material was 586,814 tons, which is 229,097 tons less than in the preceding year; on foreign order were shipped 120,886 tons, or 20.46 per cent. Of rolled shapes, 384,743 tons, or 57,077 tons less than the previous year were shipped, of which only 12,183 tons, or 3.22 per cent, were sold on foreign order. The shipments of steel bars amounted to 279,456 tons; the exports of steel bars could have been much higher, says the report, if the steel works had been free from the fetters of government control, this being the more regrettable as it evidently caused the loss of several important markets to foreign competitors. The figures in the table represent the shipments in tons of the various products during the individual months of the business year.

MONTHLY SHIPMENTS OF GERMAN STEEL PRODUCTS

Month, In Tons	Semi-finished Material	Railroad Material	Rolled Products	Total	Increase or Decrease, 1918
July—1919	42,712	55,491	37,598	135,801	—63,181
August	34,762	62,008	40,542	137,312	—68,626
September	58,254	61,147	42,233	161,634	—21,960
October	26,412	59,632	36,233	122,277	—30,892
November	19,084	43,122	34,988	97,194	— 9,106
December	18,967	51,666	30,097	100,730	— 5,057
January—1920	12,543	33,412	27,164	73,119	—52,242
February	19,062	39,830	29,338	88,230	—42,990
March	22,516	36,563	27,687	86,766	—63,150
April	21,858	42,581	27,872	92,311	—30,088
May	17,200	45,164	26,060	88,484	—28,204
June	21,332	56,198	24,931	102,461	—13,274
Total tons	314,762	586,814	384,743	1,286,319	—410,721

Metal Trades in Southeast Show Appreciable Gain

Business conditions in the Southeast have taken an upward trend the past two or three weeks which appears to give every promise of a return to normal—or at least something like normal—within the next thirty or sixty days. There is a much better feeling in industrial circles as regards the outlook for the future than has existed in this section for many months.

Financially the South is in bettter shape than it has been for some time, with money more easy to obtain and rates of interest gradually descending. Reporting for the Sixth Federal Reserve District, which comprises the group of states in the Southeast, the Federal Reserve Bank of Atlanta estimates that at least 50 or 60 per cent of last year's cotton crop is still being held, and that approximately half of the amount held is pledged as collateral for loans. The volume of loans being made throughout the district, according to the report, is generally larger than for the same period in 1920, which would indicate that the money market in this section is rapidly assuming stability, for at this time a year ago loans were very easy to obtain.

The Birmingham Boom

Men of the iron, steel and metal trades industries in this section generally regard conditions in the Birmingham district as a barometer reflecting conditions thoughout the whole South, and therefore a great deal of optimism is prevalent because of the wide-spread resumption of activities during the past two weeks in many of the foundries, shops and plants in the Birmingham district. It is generally believed that the period of depression has become a thing of the past and that the iron, steel and kindred industries of the South will continue to experience steady improvement from now on until the full return to normal has been reached.

At Anniston, Ala., which is one of the largest soil pipe manufacturing centers in the country, it is estimated that at least 2,000 employees are now at work in the various foundries and shops, a number of which only resumed operations the latter part of March. Several other pipe plants in the district, principally at Bessemer and Birmingham, also resumed operations the latter part of March, and as these plants are the largest consumers of pig iron in the South the resumption of activity presages a revival in the demand for pig iron. While no immediate response is anticipated expert opinion is that the iron now on hand will soon be worked off if structural operations continue to gather pace as they have been doing.

Blast furnaces in the district, most of which closed down a few weeks ago, are expected to resume shortly. The largest stack of the Woodward Iron Co., near Bessemer, Ala., was touched off the latter part of March, and is the first of the larger furnaces to resume in response to the betterment in conditions affecting the iron making industry. The iron market remains sluggish, small lots for immediate shipment being the principal business obtained, but the resumption of activities at many of the foundries in the district means that they will shortly exhaust their present pig iron stocks and the market will undoubtedly become active again.

The Tennessee Coal, Iron and Railroad Co. has resumed operations at the blooming and plate mills in Fairfield, and every steel mill in the district is now running either on part or full time schedule.

Alabama a Big Reducer

According to an official report of the American Iron and Steel Institute, which has just been made public, Alabama produced during 1920 a total of 2,392,962 tons of pig iron. Figures previously announced in the *American Machinist*, but which were unofficial, gave the state 2,354,803 tons for 1920, only 38,159 tons under the official figures now available.

The total for the year was greater than the ouput for 1919, when the output of the furnaces amounted to 2,130,092 tons. Only the years of 1916, 1917 and 1918 exceed those of 1920 in the amount of pig iron produced, but it must be remembered that these were years during the greatest activity of the World War when metal of all kinds was in demand. During the first six months of 1920 Alabama produced a total of 1,225,236 tons of pig iron, the slump in the iron market causing the total figure for the year to fall considerably below estimates made while business conditions were flush and the demands were greater.

Sale of Motorized Equipment by War Department

The Director of Sales, War Department, announces sales of motorized vehicles, trailers and bicycles to be held through the agency of the Quartermaster Corps as follows: At Camp Normoyle, San Antonio, Tex., during the week beginning April 11; at El Paso, Tex., during the week beginning April 18; at Jeffersonville, Ind., during the week beginning April 25; at Schenectady, N. Y., during the week beginning May 1.

These dates are tentative and subject to revision. Sales will be conducted under the general policies and procedure in effect at the recent disposal of motorized equipment at Camp Holabird, Md.

The classification and final inventory of the various motor vehicles and equipment is now being made. Prior to the opening date of each sales and in ample time to permit buyers to make inspections a detailed list of all items to be offered will be available. This list and other definite information may be obtained upon request from the officer in charge of motor transport activities at the respective camps.

Federal Highway Council Urges Store-Door Delivery

Railway traffic executives in Eastern territory now have before their committee a proposition from the transportation committee of the Federal Highway Council to make a larger use of the highway and motor truck in the store-door collection and delivery of freight.

Numerous meetings of the council's committee have been held to determine the proper policy in approaching this important subject. The proposition now before railway executives is the concrete result of these meetings.

In determining the class of traffic which would economically come under the new plan of delivery, J. C. Lincoln, traffic manager of the Merchant's Association of New York, has had embodied in the plan of procedure the principle that store-door delivery should apply to all station or platform delivery. This would exclude carload lots delivered to sidings, but would include carload lots handled over freight platforms at terminals. In most smaller cities carload lots are seldom handled over platforms, while at New York City a large portion of the freight is so handled whether it is carload or less than carload lot.

A Concrete Proposition

A motion has also been adopted to the effect that "the committee deems it most advantageous to have store-door delivery a carrier service, but at additional rates not included in the through rates." It was brought out in the discussion that store-door delivery tariffs should be published separately, similar to the lighterage tariffs of New York.

Upon the suggestion of William J. Pitt, of Philadelphia, the committee has adopted a recommendation that "the carriers, to avoid congestion and delay, be urged to establish and operate in all large cities a store-door collection and delivery system to be performed by, or under the control of the carrier, the carrier to assume liability for the safe transfer by their representatives, a reasonable charge to be assessed for such service."

Government Needs Topographic Draftsmen

The United States Civil Service Commission states that there are openings in the government service for copyist topographic draftsmen at entrance salaries of $900 to $2,000 a year; hydrographic and topographic draftsmen at entrance salaries of $1,600 to $2,000 a year, and junior topographers (topographic aids) at entrance salaries of $720 to $1,500 a year.

In addition to the basic salaries appointees whose services are satisfactory will be allowed the increase of $20 a month granted by Congress.

Full information and application blanks may be obtained by communicating with the United States Civil Service Commission, Washington, D. C.

Robert A. Bole Dies at Pittsburgh

Robert Alexander Bole, age 62, vice-president, director and district sales manager of Manning, Maxwell & Moore, Inc., died on April 2 in the Schenley Hotel, Pittsburgh, Pa., where he made his home. Mr. Bole was well-known in the iron, steel and railroad circles where he gained a nation-wide prominence.

ROBERT A. BOLE

He was born in Old Allegheny City, a son of the late Robert and Euphemia Kirkpatrick Bole. He received his education in the Pittsburgh schools. In early life he became identified with the Westinghouse Machine Co. and rose from the ranks to secretary of that company. Following his long and faithful service with the Westinghouse interests, he became identified with the large manufacturing company of Niles-Bement-Pond Co. and, after serving with them, resigned his position to become associated with Manning, Maxwell & Moore, Inc. At the time of his death, he had been identified with the latter company for a period of 26 years.

Mr. Bole enjoyed a very wide circle of business and personal friends throughout the East, especially in Pittsburgh and New York City. His sterling qualities of integrity, justness and keen business judgment gained him great prominence in manufacturing and civic activities. At the time of his death, Mr. Bole was also a director of the Western National Bank of Pittsburgh and an active member of the Duquesne Club, Pittsburgh Athletic Association, Pittsburgh Country Club, Pennsylvania Society of New York and the Engineers Club of New York. In his early life he was a member of the United Presbyterian church and was later identified with the North Presbyterian church. Mr. Bole never married. A sister, Mrs. T. Charles Hare, survives.

The Edwin Poulton Foundry Co., New Orleans, La., plans to begin full operations in its new building about April 1. Castings and iron products will be made.

Business Items

Meldrum-Gabrielson Corporation, Syracuse, N. Y., has taken over the M. S. G. L. Co., Inc. It will, in addition to the manufacture of accurate limit gages and the building of special tools, etc., manufacture and sell execlusively the Gabrielson milling machine for the Gabrielson Manufacturing Corporation. Carl Gabrielson is consulting engineer; Alexander Meldrum, general manager, and A. J. Littlejohn, general sales manager.

The New Jersey Machinery Exchange of Newark, N. J., has purchased the plant and equipment of the Allaire Woodworkers Corporation at Farmingdale, N. J.

The Ideal Sheet Metal Works Co., Inc., has been organized at New Orleans, La. J. J. Kurz is the proprietor. The company will engage in a general line of sheet-metal manufacturing.

The C. G. Young Co., Inc., consulting engineers, has opened an office at 501 Fifth Avenue, New York City. The company will devote its attention to serving industrial corporations seeking more satisfactory and more profitable results by adoption of new or modified product or by changes in methods. By reason of its foreign work and connections this firm is in a position to be of special service in foreign investigations and undertakings.

Several thousand dollars worth of machinery, machine tools and equipment was destroyed by a fire which gutted the plant of the Valdosta Machinery Co., at Valdosta, Ga., March 4. The main building, 100 x 200 ft., was entirely destroyed, the total loss amounting to between $15,000 and $20,000.

The Landis Tool Co., of Waynesboro, Pa., has moved its New York office from 50 Church St., to 51 Chambers St. The change took place on April 9. M. G. Dunbar is in charge of the New York office.

Announcement is made by D. Stergias, president of the Stergias Repeating Arms Co., of Wilmington, Del., that the company has obtained an option on part of the Old Hickory munitions plant at Nashville, Tenn., where a factory will probably be established to manufacture the products of the Stergias company. Mr. Stergias was recently in the South to visit the Birmingham district where it is also planned to establish a drop-forge plant for the manufacture of gun material to be used at the factory in Nashville.

Township trustees would be given authority to buy all machinery necessary for the maintenance of township roads in a bill introduced in the Indiana General Assembly. Heretofore it has been necessary to advertise for bids on such machinery through the Board of County Commissioners, upon the recommendation of the township trustees. The bill if passed will permit the township trustees to deal direct with machinery dealers.

Increased production of 50 per cent with corresponding decrease in number of men required to accomplish it has been secured by ingenious installations of mold carrying, lifting and pouring devices in squeezers department of Modern Foundry Co., in Oakley Colony, Cincinnati, Ohio.

The Jacobs Manufacturing Co. of Hartford, Conn., manufacturer of drill chucks, has increased the capital stock of the company from $50,000 to $500,000.

W. N. Best, Inc., has sold its business to the W. N. Best Furnace & Burner Corporation, 11 Broadway, New York City, which has just been incorporated under the laws of the State of New York, with a capitalization of $1,000,000. The new company expects to conduct business in this country, and to organize companies in foreign countries where oil is procurable as fuel.

Dr. W. N. Best has given to each of the employees stock in the new company as a reward for their services, the amount of stock varying according to the length of time each employee has been with the company and the ability which each employee has developed. Dr. W. N. Best, F.R.S.A., the retiring president of W. N. Best, Inc., is the consulting engineer of the new company and has a large financial interest in it.

Announcement is made that the firm of Arison, Goodwin & Knapp, industrial engineers of Chicago, Ill., has dissolved on the retirement of L. G. Knapp. The business will be carried on with Colonel Edgar E. Arison and L. Reeves Goodwin as the senior members under the firm name of Arison, Goodwin & Associates.

The American Steel and Wire Co., Worcester, Mass., has taken bids for the construction of a one-story 40 x 110-ft. brick and steel assembly hall building at its plant in West Haven, Conn. It is hoped to award the contract soon so as to have it ready at an early date. The welfare department of the company plans the erection of assembly halls at all its plants which are not now equipped with one.

Two changes have been effected recently in the district office organization of the Cooper-Hewitt Electric Co., maker of Cooper-Hewitt lights. The Philadelphia office force has been increased by the addition of two salesmen, and the force has moved into larger quarters in the Drexel Building. The St. Louis district office has moved from the Central National Bank Building to the Title Guaranty Bank Building.

Evolution of an "American Machinist" Article — VI

At last we arrive at the Editor's desk, and the old joke about it being hard to interview the editor doesn't go in the office of the *American Machinist*. Anybody desiring to consult him can readily do so and will always find him congenial. He is here shown giving each article, in page form, his final O. K. This is the final editorial step and after a page is O. K.'d by the editor it is sent to the composing room and regarded as a closed incident. Like all editors, he is always as busy as the proverbial one-armed paper hanger. His duties are manifold and of such nature that they would make a very interesting story in themselves.

United States Council of National Defense Issues Final Report of War Industries Board

Encouragement of permanent intimate combinations or associations of industry under government supervision, involving a radical change in the present attitude of the government toward such groupings, is recommended in the final report of the United States War Industries Board just completed by Bernard M. Baruch, who was the board's chairman. This is one of the conclusions the board came to as the result of its successful direction of industry during the war in conjunction with the temporary associations of the various industries evoked by the war necessity. It is held that great public benefits in the way of prices and abundance of goods, resulting from economies in production and distribution, are capable of being effected through the mutual co-operation of members of industrial groups, and that the present governmental policy of enforced isolation and costly competition is not conducive to the general welfare.

But as the same power born of association that makes for potential benefits may also make for potential injustices, it is recommended that there be created some sort of government agency which shall supervise such associations, both for the purpose of promoting their beneficient possibilities and checking their opposite potentialities.

A concise recommendation is also made for the maintenance of a skeleton organization along the lines of the War Industries Board which by reason of its form and its peace-time contact with industry would be capable of immediate expansion and action in the emergency of another war. In this way the experience gained in the World War may be permanently capitalized. "One is led to the thought," Mr. Baruch says, "that in a similar emergency there ought not alone to be a mobilization of man power but of things and of dollars."

The report is issued in book form from the Government Printing Office, and is entitled "American Industry in the War." The preface quotes the brief report made by Mr. Baruch to President Wilson at the conclusion of the board's general work in December, 1919, in which a full and detailed history was promised. It describes the book—which contains about 150,000 words—as "an analysis and narrative of the War Industries Board, whose function it was to supervise the industries of America that the energies of each should, as far as practicable, supplement those of all others, and that all should contribute to the limit of their combined ability to one common purpose—the winning of the war."

"Communism Must Go—If Russia Is to Live"

"There is just one way for Russia to be reconstructed, and that is for Communism to fall. If Lenine wants to give in, as some people would have you believe he has apparently given in, he has just one step to take, the re-establishment of private property and the re-establishment of reward for individual effort." These are the words spoken by Captain Hugh S. Martin, of the Military Intelligence Division of the U. S. Army, at a meeting of the Merchants Association of New York, held at the Hotel Astor on April 6.

Captain Martin spent three years in Russia and is credited with the distinction of being the only loyal American admitted to the deliberations of the Bolshevik government. The Captain gave a graphic description of the rise of Bolshevism and its attending disorder and bloodshed.

"Bolshevism," he said, "is the spectacle of an insignificant minority attaining power by deception and holding by bullets that power against the will of an overwhelming majority."

"They tell you that Petrograd is dying because we blockaded Russia. A greater lie has never been spread upon a credulous people. Russia is dying today—the industry is gone—because Bolshevism has destroyed individual initiative and human ambition."

The Captain then went on to give his deepest impressions concerning Bolshevism. He declared that the four most important things he noticed about this new order were the ease with which the Bolshevist agitator manages to corrupt and poison the mind of the mass; the methods used by the agitator in organizing his adherents; the capacity of the Bolshevist for destruction, and the peculiar philosophy of the Bolshevist—or his method of converting or bewildering those who come into contact with him.

In closing Captain Martin said, "Bolshevism is not a Russian experiment, a Russian institution; it is essentially internationalism. It admits it cannot live in Russia alone, and unless it can spread its insidious doctrines throughout the world and set up a world soviet republic it has got to fall in Russia. They tell you that Bolshevism is changing. I tell you that Bolshevism will change only when Bolshevism falls."

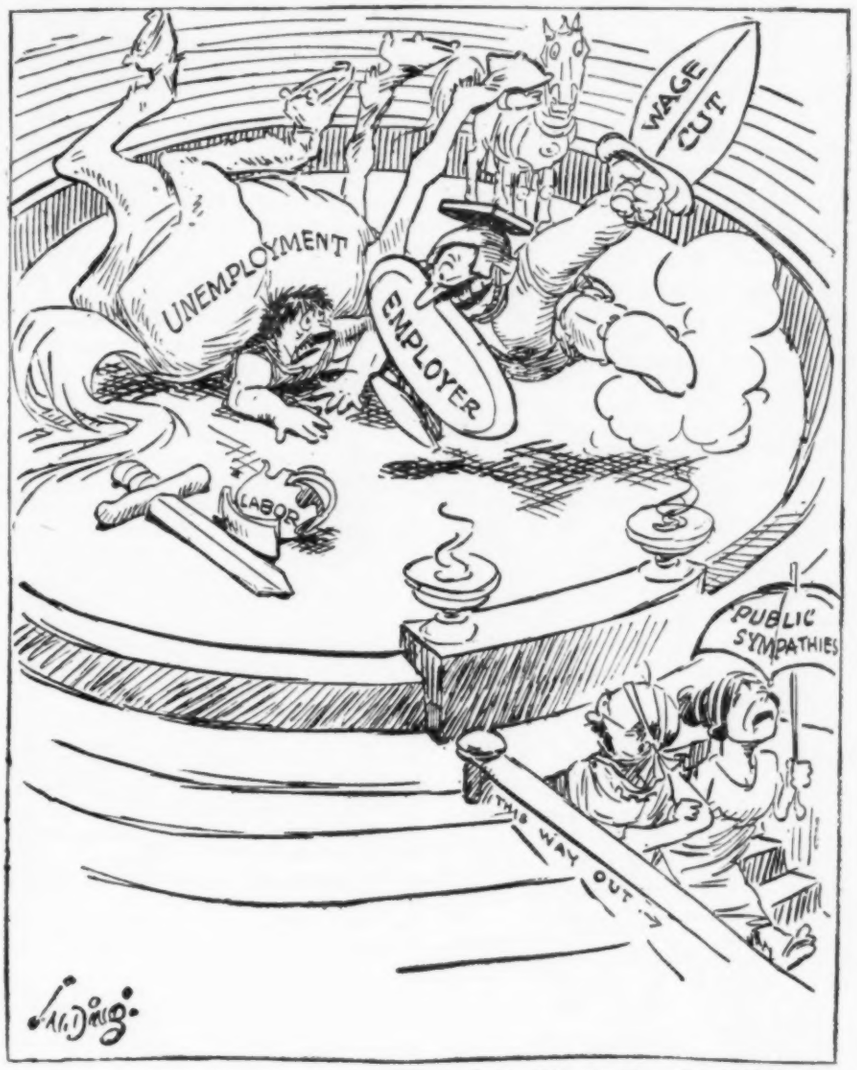
The other speaker of the day was Sir Paul Dukes, who fought in the Red Army during the revolution in Russia in 1917. Later, as a British Secret Service attaché, he spent some time investigating the theories and practices of the Soviet régime in Russia.

Sir Paul told of some of his experiences during the bloody days of the revolution. He narrated these incidents in an amusing way, but without losing sight of the lesson or the idea which he wished to bring out. On the future of Russia he had this to say: "The fate of Russia, you know, is intimately bound up with the fate of the rest of the world. Of course, no one can say when

we shall be once again in touch with that great country, a country which in a hundred years has raised itself to be on a par with the rest of the nations of the world.

"America is the greatest democracy in the world, and there is a great part for America as well as for my own country to play in the restoration of Russia, and in the teaching of Russia, how to use, how to employ this great gift of freedom which temporarily they have allowed to slip out of their hands. And if you do that, if you help us, if we work together in teaching the Russians how to do this thing, how to profit by liberty, and what duties it carries with it, I assure you, knowing the Russian people as I do, that they will not be lacking in their gratitude."

Look Out! Laurels Won in That Kind of Victory Will Only Lead to a New Challenge



J. N. Ding in New York Tribune

Personals

R. B. HUBBELL has resigned as sales manager for Churchill-Morgan-Crittsinger, Inc., to resume his former position with the Heald Machine Co., Worcester, Mass.

J. A. COWLES has severed his connection with the McVicker Engineering Co., Minneapolis, Minn.

A. D. ARMITAGE was re-elected president of the Whitman Barnes Co. of Akron, Ohio, at the annual meeting of the stockholders. Other officers elected include: C. E. Sheldon, chairman of the board of directors; A. B. Hall and R. S. Carter, vice-presidents; E. A. Fisher, secretary and treasurer; S. H. Tuttle, assistant secretary. Directors other than officers elected were: George Hill, C. B. Raymond, F. A. Siberling, A. H. Cummings and J. R. Nutt.

JAMES R. LOWE has been made general sales manager of the Harrisburg Foundry and Machine Works, Harrisburg, Pa., having previously been sales engineer with the Midwest Engine Co., Anderson, Ind.

E. L. JOHNSON was re-elected president and general manager of the Rubber City Tool and Templet Co., Akron, Ohio, at the annual meeting here last week; W. A. Skelton, of Cleveland was named vice-president. Other officers are: W. D. Ernsberger, treasurer; Mrs. J. H. McWade, secretary; J. H. McWade, director.

ALBERT J. ROMER, formerly mechanical engineer of the New Departure Manufacturing Co., Bristol, Conn., and more recently chief engineer and designer of the Northway passenger car of the Northway Motors Corporation, Natick and Boston, Mass., has formed the Romer Motors Corporation, Boston, Mass. A factory for the manufacture of passenger cars will be erected at Danvers, Mass.

CLARENCE M. DAVISON, until recently manager of the service station Aslop Motor Corporation, Richmond, Va., is now general superintendent of the Poole Engineering and Machine Co., Baltimore, Md.

GEORGE H. KENDALL is now with the Jefferies-Norton Corporation of Worcester, Mass. He was formerly in the standards department of Norton Co. of Worcester.

CARL W. BETTCHER has been appointed sales manager of the Eastern Machine Screw Corporation, New Haven, Conn. Mr. Bettcher will devote his attention especially to the expansion of sales of H. & G. die heads.

FRED W. CEDERLEAF has resigned as chief engineer of the Sparks-Witherington Co., of Jackson, Mich., and has joined the Zeigler Manufacturing Co. as works engineer.

C. L. SMITH has joined the staff of the Moore Iron Works, Inc., 1600 E. Missouri St., El Paso, Tex., in the capacity of sales manager. The company specializes in all sorts of structural steel and cast iron work.

G. S. MARTINDALE has severed his connections as resident engineer for the General Motors Corporation, St. Louis, Mo., to become works engineer for the Champion Coated Paper Co., Hamilton, Ohio.

E. T. SPIDY has resigned his position as production engineer of the Angus shops of the Canadian-Pacific Ry., to take a position as assistant superintendent of the Dominion Engineering Works, Montreal, Canada.

C. H. PETERSON, formerly with the Iron Mountain Co., Chicago, Ill., is now vice-president and general manager of the Viking Corporation, manufacturers of automatic fire protection apparatus, Hastings, Mich.

LOUIS T. KLAUDER has resigned his position as construction engineer for the Philadelphia Rapid Transit Co. and will enter the consulting engineering field, specializing in plant design and construction.

E. E. DAVIS, manufacturing superintendent of Gilbert & Barker Manufacturing Co., Springfield, Mass., recently resigned his position with the company.

S. A. HUGHES, assistant to the works manager at the plant of Gilbert & Barker Manufacturing Co., Springfield, Mass., recently resigned his position with the company.

J. F. CARATINI of the general sales department of the Gilbert & Barker Manufacturing Co. of Springfield, Mass., recently returned to this country after nearly a year spent in Porto Rico and the Dominican Republic in the interests of his company.

WILLIAM ROBERTS, formerly connected with the engineering department of the Rolls-Royce of America, has established offices at 457 Main St., Springfield, Mass., under the name of the Engineering School of Drawing. He will specialize on production and efficiency work and designing of tools and special machines.

GUSTAVE BATTIN, for a number of years Paris sales engineer for the Allied Machinery Co. of Paris, has been elected a director of the C. E. Carpenter Co., Société Anonyme of Paris, dealers in American machine tools. Mr. Battin will look after sales in the Paris district.

J. W. STANNARD, secretary-treasurer of the American Auto Parts Co. of Detroit, Mich., has been elected first vice-president of the Industrial Cost Association.

H. S. PECK, controller of the S. K. F. Industries, Inc., has been made national director of the Industrial Cost Association.

JOHN R. COMSTOCK, assistant superintendent of the blast furnaces of the Steelton, Pa., plant of the Bethlehem Steel Co., has resigned to become assistant to the general manager of the M. A. Hanna Co. of Cleveland, Ohio, the latter firm marketing ore and pig iron. Mr. Comstock is a former resident of Mechanicsburg and entered the Steelton plant nine years ago after graduating from Stevens Institute.

Obituary

WILLIAM HENRY RUNGE died at his home in Seneca Falls, N. Y., March 10, after an illness of three months. His death was not wholly unexpected by his friends who knew of the unsuccessful attempt last Spring to relieve him by a surgical operation. Mr. Runge was born in Syracuse, N. Y., March 13, 1867, but had been a resident of Seneca Falls, N. Y., the greater part of his life.

Born into what would today be considered a large family and having the advantage of but a common school education, he was obliged early in life to take up the battle for a livelihood. Denied the advantages of a university training and education, which with his natural endowments, would doubtless have aided in placing him among the foremost mechanical engineers of this age, by his untiring industry and devotion to his chosen vocation and liberal application of common sense with which he was richly endowed, he overcame many of the handicaps with which he started in life. The Golden Rule was his code, perhaps without being conscious of it. He very naturally won for himself a large circle of friends whose loyalty could never be questioned.

For practically thirty years he was an important member of the organization of the Seneca Falls Manufacturing Co., Seneca Falls, N. Y., and during the past fifteen years served as mechanical engineer. During this period he was the originator of many improvements in the lathe design, as is evidenced by the fourteen or more U. S. patents that have been granted him covering many novel and valuable features of lathe design.

Although Mr. Runge had specialized in lathe design, he was nevertheless a versatile mechanic and was unsatisfied with anything that engaged his attention until he had carried it at least one step nearer perfection. His finer sense of the appropriate would not permit him to identify himself with anything impractical or mediocre. Fabrication of parts interested him no less than the design, and consequently many improved tools and methods were introduced by him for the production of tools and machinery. He quietly and persistently followed his ideals, worked out his conceptions and left his impress on things, always for the better.

He is survived by his wife, Elizabeth Garling Runge of Seneca Falls, N. Y., and two brothers, Fred W. Runge of Painted Post, N. Y., and Ernest A. Runge of Paterson, N. J.

HENRY ATWATER, a prominent manufacturer for the past forty years in Bridgeport, Conn., died at the Bridgeport Hospital March 19. Mr. Atwater was 77 years old. He came to Bridgeport in 1879 to start the Bridgeport Malleable Iron Works, now a subsidiary of the Eastern Malleable Iron Co. of Naugatuck, Conn., and he was a director and also secretary of that concern up until 1906, when he retired from the business. Mr. Atwater is survived by his wife and one son, Fred Atwater, secretary of the Columbia Nut and Bolt Co. of Bridgeport.

ELIE MILLETT, inventor of the Millett-Core Oven and also founder of the Millett Brass Co., now the Harley Co. of Springfield, Mass., died at his home in Springfield on March 19 after a long illness. Mr. Millett was 69 years old and had been a resident of Springfield for the past fifty years. He was well known throughout the East in manufacturing circles.

ALBERT H. WOLF of New York, a well known engineer, died at Atlantic City, N. J., on March 13. Mr. Wolf had been active in many railroad and marine engineering enterprises, prominent among which was the construction of the Eads bridge acros sthe Mississippi River at St. Louis.

CHARLES SILBERZAHN died at his home at West Bend, Mich., on March 12. He was 92 years old. In partnership with his son he conducted a foundry and machine shop business at West Bend. He was well known in that section of the country as a machine builder and designer.

ADDISON STEVENS HODGES, for two generations a leading figure in the foundry and hardware business in New England, died last week at Somerville, Mass., in his ninetieth year. He was engaged in the foundry business for seventy years, first at the Wheeler foundry in Worcester and later in Hyde Park, Chelsea, Somerville and Lynn, Mass.

ANDREW J. CORCORAN, founder and president of A. J. Corcoran, Inc., Jersey City, N. J., died on March 9. He was a pioneer in the foundry and machine building industry in New Jersey.

Forthcoming Meetings

The National Metal Trades Association will hold its annual convention at the Hotel Astor, New York, on April 20 and 21. Homer D. Sayre, Peoples Gas Building, Chicago, Ill., is secretary.

The fifth annual convention of the American Gear Manufacturers Association will be held in Cincinnati, Ohio, April 27, 28, 29 and 30.

The ninth annual meeting of the Chamber of Commerce of the United States will be held at Atlantic City, April 27 to 29, with headquarters at the Traymore Hotel.

The annual meeting of the American Welding Society will be held in the Engineering Societies Building, 29 West 39th St., New York, on April 28.

The Society of Industrial Engineers will hold its national convention in Milwaukee, Wis., on April 27, 28 and 29. Geo. C. Dent, 327 So. La Salle St., is business manager.

The National Foreign Trade Council will hold its eighth annual convention in Cleveland, Ohio, on May 4, 5, 6 and 7. J. G. Hammond, care of the Council, 409 Park Bldg., Cleveland, is secretary.

A triple convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will be held in Atlantic City, N. J., May 16, 17 and 18, 1921, with headquarters for all three associations at the Marlborough-Blenheim. F. D. Mitchell, 4106 Woolworth Building, New York, is secretary of the last-named association.

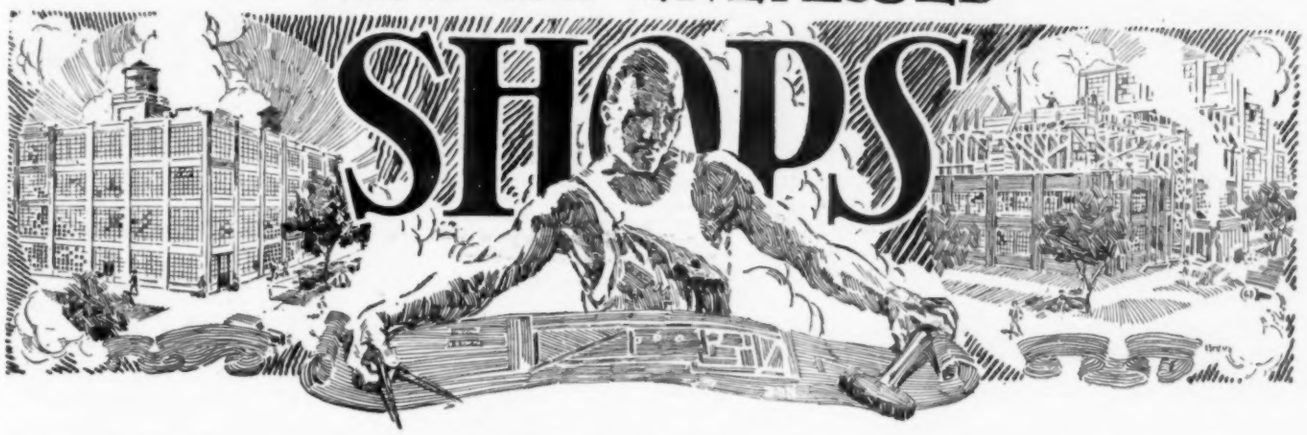
The spring meeting of the National Association of Manufacturers will be held in New York, May 16, 17 and 18 at the Waldorf-Astoria Hotel. The headquarters of the association is at 30 Church St., New York City.

Announcement is made that the regular spring meeting of the National Machine Tool Builders Association will be held in Atlantic City, N. J., on May 24 and 25. Headquarters will be at the Traymore Hotel. Ernest F. Du Brul, 817 Provident Bank Bldg., Cincinnati, Ohio, is general manager.

The spring meeting of the American Society of Mechanical Engineers will be held at the Congress Hotel, Chicago, May 23-26. Calvin W. Rice, Engineering Societies Bldg., 29 West 39th St., New York, is secretary.

The Society of Automotive Engineers, 29 West 39th St., New York announces that its summer meeting will be held at West Baden, Ind., on May 24 to 28 inclusive.

NEW and ENLARGED



Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

Mass., Springfield — Genden Bros., 28 Morgan St.—auto repair equipment.

Mass., South Walpole—The Bird Machine Co.—20 in. to 24 in. shaper.

Mass., Worcester—The Reed & Prince Mfg. Co., Duncan Ave., manufacturer of screws—one LaPointe No. 3 broaching machine and one No. 2 Brown & Sharpe surface grinder.

Mass., Worcester—The M. S. Wright Co., 51 Jackson St., manufacture of vacuum cleaners—1 beading machine for spinning beads on ferrules.

D. C., Washington—G. H. Rettew, 2357 Rhode Island Ave., N.E.—power bender for bending up to 1¼ in. reinforced bars, electrically driven, prefer without motor.

N. J., Harrison—The New Jersey Tube Co., Kingsland Ave.—6 buffing jacks with tight and loose pulley to take at least a 4 in. belt and one 1½ Bliss Torgle double action press.

N. Y., Buffalo—J. J. Bresnaham Heating and Plumbing Co., 462-464 Elk St.—pipe cutting machine to cut from 1 in. to 6 in. pipe, also shafting and pulleys for same (new or used).

N. Y., Buffalo — W. A. Franklin, 243 Crescent Ave.—
One planer with table 6 ft. or 8 ft. long x 48 in. or 54 in. wide.
One 20 or 24 in. lathe 10 ft. between centers with taper attachment.
One 16 in. shaper.
One medium horizontal milling machine. (First class used equipment preferred.)

N. Y., Carthage—D. J. Renaud & Son, Inc., D. J. Renaud, Purch. Agt.—foundry and machine shop equipment.

N. Y., Gouverneur—J. Russell, West Main St.—drill press, 16 in. back geared engine lathe (new or second hand), and miller.

N. Y., Watertown—The Watertown Steam Vulcanizing Wks., W. F. Rogers, Purch. Agt.—one 16 in. engine lathe.

Ga., Austin — Austin Bros., Greenwood Ave. and Southern Ry. E. C. Knodel, Jr., Mgr.—cranes, punches, shears and power riveters.

N. C., Wilmington—Carter's Production Wks., 210 South Water St., O. Carter, Mgr. —one 6 x 15 four side planer.

Ill., East St. Louis — The Dependable Truck & Tractor Co., 231 Collinsville Ave. —lathes, drill presses and cranes.

Ind., Wabash—The Service Motor Truck Co.—complete equipment for the manufacture of motor trucks and auto parts.

Mich., Detroit—F. Laskowski, 3134 East Jefferson St.—16 x 6 screw cutting lathe with compound rest.

Mich., Howell—The Howell Washing Machine Co.—lathe, drill press and automatic tapper.

O., Lorain — Longs Garage — 16 x 18 lathe, No. 2 Brown and Sharpe grinder, 20 in. drill press (used).

Wis., Milwaukee—The Badger Machinery Co., 270 4th St., F. Kebbekus, Purch. Agt. —additional machine shop equipment for the manufacture of tools, dies, etc.

Wis., Milwaukee — E. A. Krause, 2908 North Ave. manufacturer of auto springs —power punch, drop forge and emery wheel.

Wis., Milwaukee—The Snap-On-Wrench Co., 1266 South Pierce St., W. Stideman, Purch. Agt.—punch press, drill press and grinders.

Ia., Ottumwa—The Ottumwa Iron Wks. —one No. 2 or No. 3 Long and Allstatter double end punch and shear (second hand).

N. B., Moncton—The Record Fdry. and Machine Wks.—machinery.

Tex., Waco—The Fox Sharpener Co., J. Nelson, Treas.—die casting or drop forging specialties for use in the manufacture of safety razor blade sharpeners.

Ont., Ottawa—The Bd. of Control—tools for proposed work shop and garage.

Ont., Ottawa—The city—some machine shop tools.

Machinery Wanted

N. J., Camden—The Bd. of Freeholders, Camden Co.—bakery, kitchen and ice refrigerating equipment, etc., for proposed almshouse and infirmary at Asyla (Grenlock P. O.).

N. J., Trenton—The Trenton Poster Advertising Co., Lambert St. — one electric paste mixer machine.

N. Y., Bridgeport—G. Phillips—saw mill equipment.

N. Y., Buffalo—The Rox Concrete Products Corp., foot of Ferry St., E. G. Roquemore, Pres. — automatic concrete block making machinery or partition tile machine, also helm or other automatic face brick machine (used).

N. Y., Chaumont—The Adams & Duford Co. manufacturer of crushed limestone, E. B. Johnson, Purch. Agt.—concrete mixer and limestone pulverizer.

N. Y., New York (Borough of Brooklyn)—J. Leisenheimer 54 Bogert St.—one 100 lb. hammer.

N. Y., Watertown—The St. Regis Paper Co., Trust Co. Bldg.—special machinery for the manufacture of fibre shipping cases.

Fla., Tallahassee—The Tallahassee Lumber Co., D. M. Lewis, Vice-Pres. and Genl. Mgr.—one 14 x 18 in. or 16 x 20 in. timber sizer; two 6 x 15 in. planers and matchers; one 6 x 8 in. moulder (outside) and one 24 in. circular resaw.

S. C., Embree—The Edisto River Lumber Co., D. A. Gardner, Mgr.—complete equipment for 8 or 9 ft. band saw mill.

Ill., Chicago—The Ford Roofing Products Co., 2339 LaSalle St.—one No. 6½ or No. 7 style D Reeves Drive.

Ill., Mineral — The Bd. Educ. — manual training equipment for high school.

Ill., Winchester—The Bd. Educ.—manual training equipment.

Wis., Milwaukee—J. Dabs, 1341 40th St. —wood-working machinery.

Wis., Milwaukee—J. R. Lamboy, 16 Mack Blk.—portable saw mill.

Wis., Milwaukee—D. Tuft, 2447 Brown St.—planer about 12 ft. to 14 ft. long and 3 ft. wide for cut stone shop.

Wis., Two Rivers—The Wisconsin Textile Mfg. Co., c/o G. C. Hirst, Mgr.—power machinery and machinery for the manufacture of textile supplies.

Ont., London—The Utilities Bd.—equipment for proposed smelting plant.

Ont., Stayner—The Georgian Bay Milling & Power Co.—equipment for its proposed flour mill.

Ont., Wallaceburg—The Wallaceburg Cut Glass Ltd.—equipment for proposed glass manufacturing plant.

Que., Montreal — The Imperial Knitting Mills, 200 Waha Roche St.—equipment.

Que., Montreal—The Maisoneuve Box & Board Co., Maisoneuve St.—equipment.

Que., St. Hyacinthe—A. St. Germain—biscuit and confectionary making machinery.

Metal Working

NEW ENGLAND STATES

Conn., Hartford — T. R. Forrestere, Charter Oak Pl., will soon award the contract for the construction of a 2 story, 24 x 50 ft. garage and a 2 story, 12 x 50 ft. addition to bottling plant. Estimated cost, $18,000. B. R. Sellew, 223 Asiyum St. Archt.

Conn., New Haven — F. Teitelman, 146 State St., has awarded the contract for the construction of a 1 story, 45 x 60 ft. garage with a 30 x 50 ft. ell, on Howard Ave. Estimated cost, $20,000.

Mass., Boston—E. G. Isenbeck, 120 Milk St., is having revised plans prepared for the construction of a 2 story, 90 x 300 ft. garage on Boylston St. J. C. Spofford, 36 Bromfield St., Archt. and Engr.. Noted Nov. 11.

Mass., Boston—Pope & Cottle Co., 140 Carter St., will soon award the contract for the construction of a 1 story, 50 x 65 ft. garage. Estimated cost, $20,000. Monks & Johnsoon, 99 Chauncey St., Archts. and Engrs. Noted March 17.

Mass., Brockton—A. Oppenheim, 20 School St., Boston will build a 1 story, 70 x 100 ft. garage on Montello St., here. Estimated cost, $30,000. Noted March 31.

Mass., Danvers—The Romer Motor Sales Corp., 51 Cornhill St., Boston, plans to construct a 2 story, 100 x 800 ft. paint and assembly building and a 1 story, 100 x 500 ft. manufacturing plant on Water St.

Mass., Lowell—Katz Bros., c/o Tuck & Gilman, Archts. and Engrs., 34 School St., Boston, are having plans prepared for the construction of a 1 story, 100 x 112 ft. garage.

THE WEEKLY PRICE GUIDE

This Week's Market

No price changes either in Chicago or Cleveland. Prices at New York warehouses lower for cold finished steel, hoop and strip steel, floor plates, machine bolts and structural rivets. Copper nickel ingots are now 45c. per lb. instead of 52c. as formerly. Solder, half and half, is down 1c. per lb., to 18c.

The metal market is stronger than last week. Copper, tin, lead and zinc have all advanced from ¼c. to ½c. per lb.

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	$30.50
Northern Basic	27.52
Southern Ohio No. 2	30.50
NEW YORK—Tidewater Delivery	
Southern No. 2 (Silicon 2.25 to 2.75)	36.51
BIRMINGHAM	
No. 2 Foundry	26.50
PHILADELPHIA	
Eastern Pa., No. 2x, 2.25–2.75 sil	27.00
Virginia No. 2	*28.00
Basic	†26.25
Grey Forge	*27.00
CHICAGO	
No. 2 Foundry local	26.00
No. 2 Foundry, Southern, sil 2.25@2.75	33.00
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	26.96
Basic	26.86
Bessemer	27.00

* F. o. b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Warehouse Jersey City	New York Delivered	Cleveland	Chicago
Structural shapes	$3.23	$3.33	$3.58	$3.58
Soft steel bars	3.13	3.23	3.34	3.48
Soft steel bar shapes	3.13	3.23	3.48	3.48
Soft steel bands	4.18	4.28	6.25	
Tank plates	3.23	3.33	3.78	3.78

BAR IRON—Prices per 100 lb. at the places named are as follows:

Mill, Pittsburgh	$2.25@$2.35
Warehouse, New York, delivered	3.13
Warehouse, Cleveland	3.52
Warehouse, Chicago	4.12

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	New York,	Cleveland	Chicago
No. 10	3.20@3.55	4.23	4.00	4.68
No. 12	3.25@3.60	4.28	4.05	4.73
No. 14	3.30@3.65	4.33	4.10	4.78
No. 16	3.40@3.75	4.43	4.20	4.88
Black				
Nos. 17 and 21	3.75@4.15	4.80	4.70	5.55
Nos. 22 and 24	3.85@4.20	4.85	4.85	5.60
No. 25 and 26	3.90@4.25	4.90	4.90	5.65
No. 28	4.00@4.35	5.00	5.00	5.75
Galvanized				
No. 10 and 11	4.25@4.70	4.43	5.00	6.10
No. 12 to 14	4.35@4.80	4.53	5.10	6.20
Nos. 17 and 21	4.65@5.15	4.83	5.40	6.50
Nos. 22 and 24	4.80@5.25	4.98	5.55	6.65
No. 26	4.95@5.40	5.13	5.70	6.80
No. 28	5.25@5.70	5.38	6.00	7.10

COLD FINISHED STEEL—Warehouse base prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb	$4.73	$5.25	$4.84
Flats, squares and hexagons, per 100 lb	5.23	5.75	5.34

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent
New York	50%
Cleveland	50%
Chicago	50%

NICKEL AND MONEL METAL—Base prices in cents per pound, any quantities, f.o.b. Bayonne, N. J.

Nickel	
Ingots and hot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	42
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55

Special Nickel and Alloys	
Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, Grade "A" and "C" (base)	72
Copper nickel ingots	37
Hot rolled copper nickel rods (base)	45
Manganese nickel hot rolled (base) rods, "D"—low manganese	64
Manganese nickel hot rolled (base) rods "D"—high manganese	67

Electric Welding Wire—Welding wire in 100-lb. lots sells as follows, f.o.b. New York: 1/32, 8½c. per lb.; ⅛, 8c.; 5/32 to ½, 7½c. Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York	Cleveland	Chicago
Openhearth spring steel (heavy)	6.00	8.00	9.00
Spring steel (light)	8.00	7.00	12.00
Coppered Bessemer rods	8.50	8.00	7.00
Hoop steel	4.38	4.04	4.18
Cold rolled strip steel	8.50	8.25	9.25
Floor plates	5.50	4.00	6.03

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card:

BUTT WELD

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
⅛ to 3	57½%	44%	¼	15½–16½%	+10½–11½%
			⅜	19½–20½%	1½– 2½%
			½ to 1¼	24½–25½%	8½– 9½%

LAP WELD

2	50½%	38%	2	20½–21%	6½– 7%
2½ to 6	53½%	41%	2½ to 6	22½–23%	9½–10%
7 to 12	50½%	37%	7 to 12	19½–20%	6½– 7%
13 to 14	41%				
15	38½%				

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛ to 1¼	55½%	43%	¼ to 1¼	24½–25½%	9½–10½%
2 to 3	56½%	44%			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	48½%	37%	2	21½–22½%	8½– 9%
2½ to 4	51½%	40%	2½ to 4	23½–24%	11½–12%
4½ to 6	50½%	39%	4½ to 6	22½–23%	10½–11%
7 to 8	46½%	33%	7 to 8	14½–15%	2½– 3%
9 to 12	41½%	28%	9 to 12	9½–10%	+2 –2½%

Warehouse discounts as follows:

	—New York— Black	Galv.	—Cleveland— Black	Galv.	—Chicago— Black	Galv.
⅛ to 3 in. steel butt welded	44%	28%	42½%	33½%	57½%	44%
2½ to 6 in. steel lap welded	39%	24%	44½%	29½%	53½%	41%

Malleable fittings. Classes B and C, Banded, from New York stock sell at plus 6%. Cast iron, standard sizes, 15% off.

METALS

MISCELLANEOUS METALS—Present and past New York jobbers' quotations in cents per pound, in quantities up to car lots:

Copper, electrolytic	13.50@13.75
Tin in 5-ton lots	31.50
Lead	4.75@5.00
Zinc	6.50@6.75

ST. LOUIS

Lead	4.35@4.60
Zinc	6.10@6.35

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York	Cleveland	Chicago
Copper sheets, base	20.00	21.50	23.50
Copper wire (carload lots)	15.00	17.50	20.00
Brass sheets	17.25	24.00	24.50
Brass pipe	21.00	22.00	20.75
Solder (half and half) (case lots)	18.00	20.50	17.50

Copper sheets quoted, above hot rolled 24 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are in cents per pound at warehouse:

New York	15.25
Cleveland	19.00
Chicago	18.75

SHOP MATERIALS & SUPPLIES

ZINC SHEETS—The following prices in cents per pound are f. o. b. mill + less 8% for carload lots..... 11.50

	Warehouse	
	In Casks	Broken Lots
New York	12.00	12.50
Cleveland	13.70	14.30
Chicago	15.75	16.25

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

New York	5.50@6.00
Chicago	6.25
Cleveland	7.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Copper, heavy, and crucible	10.00	10.00	10.00
Copper, heavy, and wire	9.00	9.50	9.00
Copper, light, and bottoms	8.00	9.00	8.00
Lead, heavy	3.25	4.00	3.50
Lead, tea	2.00	3.00	3.00
Brass, heavy	6.00	7.00	9.00
Brass, light	4.50	5.00	5.00
No. 1 yellow brass turnings	5.00	5.50	5.50
Zinc	3.00	3.00	3.10

ALUMINUM—The following prices are spot from warehouse, cents per pound:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	28.1@28.2	24.50	30.00

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current
New York (round)	22.00
Chicago	20.50
Cleveland	22.00

BABBITT METAL—Warehouse price in cents per pound:

	New York	Cleveland	Chicago
Best grade	70.00	46.00	35.00
Commercial	30.00	16.50	9.00

NOTE—Price of babbitt metal is governed largely by formula, no two manufacturers quoting the same prices. For example, in New York, we quote the best two grades, although lower grades may be obtained at much lower prices.

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York	Cleveland	Chicago
Hot pressed square	List	$1.00	+1.15
Hot pressed hexagon	List	1.00	+1.15
Cold punches hexagon	List	1.00	+1.15
Cold punched square	List	1.00	+1.15

Semi-finished nuts, ⅞ and smaller, sell at the following discounts from list price:

	Current
New York	60%
Chicago	70%
Cleveland	70%

MACHINE BOLTS—Warehouse, discounts in the following cities:

	New York	Cleveland	Chicago
All sizes up to 1 by 30 in	50-10%	60%	50%
1¼ and 1½ in. by 3 in. up to 12 in	50%	50%	45%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York..... $2.00 Cleveland..... $3.50 Chicago..... $2.50
For cast-iron washers, ¼ and larger, the base price per 100 lb. is as follows:
New York..... $4.50 Cleveland..... $4.00 Chicago..... $4.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	40%	50%	40%
Larger and longer up to 1 in. by 30 in	40%	40%	40%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets	Burs
Cleveland	40%	10%
Chicago	net	net
New York	40%	25%

RIVETS—The following discounts are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	50%	50%	45%
Tinned	45%	50%	30%

Structural, ½, ⅝, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York...$4.85 Cleveland...$5.00 Chicago....$5.08 Pittsburgh..$3.90
Boiler, same sizes:
New York...$4.95 Cleveland...$5.10 Chicago....$5.18 Pittsburgh..$4.00

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	22.25	25.00	25.50
Brass	21.00	24.00	24.50

Prices vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities less than 25 lb. add 10c. per lb.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ¼-2 in., inclusive in rounds, and ½-1½ in., inclusive in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $0.75.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $7.70 per 100 lb. In Cleveland—$8.50 per 100 lb.; New York price is 8c.

COTTON WASTE—The following prices are in cents per pound:

	New York Current	Cleveland	Chicago
White	10.00@13.00	13.00	14.25
Colored mixed	7.00@11.50	10.00	12.00

WIPING CLOTHS—Jobbers' price per 1,000 is as follows:

	13½x13½	13½x20½
Cleveland	$55.00	$65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current
New York (5 bbl.)	$2.10
Philadelphia (5 bbl)	1.85
Cleveland	3.25
Chicago	2.50

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current
New York (5 bbl.)	$2.55
Philadelphia (5 bbl.)	2.55
Chicago	4.50

COKE—The following are prices per net ton at ovens, Connellsville:

	Current
Prompt furnace	$4.75@$5.25
Prompt foundry	5.50@6.50

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$0.80
Cleveland	100-lb. bag	1.05

LINSEED OIL—These prices are per gallon:

	Current		
	New York	Cleveland	Chicago
Raw in barrels (5 bbl. lots)	$0.73	$0.90	$0.80
5-gal. cans	76*	1.15	1.05

*Charge of $2.25 for two cans.

WHITE AND RED LEAD—Base price per pound:

	Current		
	Red		White
	Dry	In Oil	Dry and In Oil
100 lb. keg	13.00	14.50	13.00
25 and 50-lb. kegs	13.25	14.75	13.00
12½-lb. keg	13.50	15.00	13.50
5-lb. cans	16.00	17.50	16.00
1-lb. cans	18.00	19.50	18.05

500-lb. lots less 10% discount; 2,000-lb. lots less 10-4% discount; 10,000 lb. lots less 10-7½% discount.

Mass., Malden—B. Atlas, 47 Nevada St., Winthrop, will soon award the contract for the construction of a 1 story, 100 x 110 ft. garage on Main and Clinton Sts., here. Estimated cost, $50,000. Private plans.

Mass., Springfield—Ashley & Peterson, 387 Main St., have awarded the contract for the construction of a 1 story, 40 x 125 ft. garage on White St. Estimated cost, $25,000.

Mass., Springfield—Chaplin & Chaplin, 374 Main St., will build a 1 story, 49 x 110 ft. garage on Belmont Ave. Estimated cost, $20,000.

Mass., Springfield—Genden Bros., 28 Morgan St., will soon award the contract for the construction of a 1 story garage. Estimated cost, $25,000.

Mass., Worcester—R. H. Long Co., Framingham, is having plans prepared for the construction of a factory, for the manufacture of shoes and auto bodies, to include a 6 story, 75 x 600 ft., 6 story, 75 x 300 ft. and 6 story, 75 x 100 ft. buildings, on Milbrook St. along the tracks of the Boston & Maine R.R., here. Estimated cost, $1,500,000. F. H. Clark, c/o owner, Engr. S. H. Pitcher Co., 44 Front St., Associated Engr.

MIDDLE ATLANTIC STATES

N. Y., Depew—The Magnus Steel Co. Inc. has awarded the contract for the construction of a 2 story, 42 x 120 ft. mill for the manufacture of brass car journals. Estimated cost, $30,000.

N. Y., Geneva—The Geneva Automobile Co. plans to build an addition to its plant on Castle St. Cost between $30,000 and $35,000.

N. Y., New York (Borough of Brooklyn)—The Constant Motor Service Corp., c/o Ebling, Magmusen & Kleinart, Archts. and Engrs., 52 Vanderbilt Ave., New York City, will build a 1 story, 165 x 400 ft. garage on 66th St. and 5th Ave. Estimated cost, $100,000.

N. Y., New York (Borough of Bronx)—H. Froebe, c/o J. DeHart, Archt. and Engr., 1041 Fox St., has awarded the contract for the construction of a 2 story, 75 x 100 ft. garage on Intervale Ave. Estimated cost, $75,000.

N. Y., New York (Borough of Bronx)—The Hattic Realty Co., 1398 Clay Ave., has had plans prepared for the construction of a 1 story, 100 x 100 ft. garage on 135th St. near Southern Blvd. Estimated cost, $30,000. Springstein & Goldhammer, 32 Union Sq., New York City, Archts. and Engrs.

N. Y., New York (Borough of Manhattan)—S. Wachatinsky, 308 East Bway., is having plans prepared for the construction of a 3 story, 145 x 250 ft. garage on Broome and Tompkins Sts. Estimated cost, $350,000. L. A. Sheinart, 194 Bowery, Archt. and Engr. Noted March 31.

N. J., Trenton—The City Comn. plans to build a garage on Commerce St. Estimated cost, $17,000. A. Swan, Sr., 30 Wilkinson Pl., Archt.

Pa., Philadelphia — The city will soon award the contract for the construction of a 1 story, 160 x 200 ft. machine and repair shop on Clearfield and 27th Sts. Estimated cost, $120,000. J. P. B. Sinkler, City Hall, Archt.

Pa., Philadelphia—T. J. Slattery, 1008 South 46th St., will soon award the contract for the construction of a repair shop and fifty 1 story garages, on 59th St. and Baltimore Ave. E. Perot, Parkway Bldg., Archt.

Pa., Williamsport—The McCormick Motor Car Co., West 3d and Locust Sts., has awarded the contract for the construction of a 2 story, 130 x 190 ft. garage, on 3d and Hepburn Sts. Estimated cost, $75,000.

MIDDLE WEST STATES

Ill., East St. Louis — The Dependable Truck & Tractor Co., 231 Collinsville Ave., will soon award the contract for the construction of a 1 story, 100 x 250 ft. truck plant at Washington Park. Estimated cost, $250,000. Riester & Rubach, Murphy Bldg., Archts. Noted April 7.

Ill., Vandalia — The Smith Bros. Garage Co. has awarded the contract for the construction of a 3 story, 57 x 69 ft. garage. Estimated cost, $75,000.

Ill., Winthrop Harbor—The Austin Machinery Corp., Chicago manufacturer of trenching machines, backfillers, draglines, cranes, steam, gas and electric shovels, etc., plans to rebuild its plant here which was recently destroyed by fire.

Ind., Indianapolis—The F. Wood Transfer Co., 216 North Meridan St., plans to build a 3 story, 80 x 120 ft. garage on West Vermont St. Estimated cost, $80,000. Vonnegut, Bohn & Mueller, 610 Indiana Trust Bldg., Archts.

Mich., Detroit — The Bd. Educ., 1354 Bway., will soon award the contract for the construction of a 7 story, 155 x 200 ft. addition to Cass Technical High School and a 2 story, 50 x 200 ft. gas engine laboratory, on 2d and High Sts. C. A. Gadd, Business Mgr. Malcomson, Higginbotham & Palmer, 404 Moffat Bldg., Archts.

O., Cleveland — A. Horwitz, 326 Society for savings Bldg., has awarded the contract for the construction of a 1 story, 28 x 78 ft. garage on East 134th St. and Woodworth Rd. Estimated cost, $40,000.

O., Dayton—The Duplex Motor Car Co., South Perry St., plans to construct a 2 story, 40 x 160 ft. garage and auto sales building. Estimated cost, $50,000.

Wis., Cedarburg—The Lauterbach Sales Co. has awarded the contract for the construction of a 2 story, 59 x 150 ft. garage, repair shop and machine shop on Washington St. Estimated cost, $75,000.

Wis., Fond du Lac—W. H. Krug, Lakewood Beach, has awarded the contract for the construction of a 1 story, 40 x 170 ft. garage and repair shop on North Main St. Estimated cost, $42,000.

Wis., Kenosha — The Long Motor Co., 464 Park Ave., is having preliminary plans prepared for the construction of a 2 story, 72 x 132 ft. garage and repair shop on Sheridan Rd. Estimated cost, $60,000. C. O. Augustine, Archt.

Wis., Oshkosh—The Hollister Auto Co., 33 Algoma St., will soon award the contract for the construction of a 2 story, 80 x 117 ft. garage and repair shop. Estimated cost, $60,000. Auler & Jensen, F. R. A. Bldg., Oshkosh, Archts.

STATES WEST OF THE MISSISSIPPI

Minn., Faribault—J. M. Foss is having plans prepared for the construction of a 2 story, 66 x 132 ft. garage and sales building. Estimated cost, $50,000. H. H. Livingston 55 South 8th St., Minneapolis, Archt.

Minn., Minneapolis—The Western Body Mfg. Co., 763 3d St., N., is having plans prepared for the construction of a 3 story addition to its factory. Estimated cost, $45,000. C. M. Sticker, Secy. Bell & Kinports, 1620 Harmon Pl., Archts.

WESTERN STATES

Cal., Los Angeles — The Pacific Mutual Life Insurance Co., 6th and Olive St., has had plans prepared for the construction of a 2 story, 60 x 348 ft. garage at 539 South Olive St. Estimated cost $100,000. Dodd & Richards, 905 Brack Shop Bldg., Archts.

Cal., Los Angeles — E. B. Rivers, c/o Noerenberg & Johnson, Archts., 762 Pacific Electric Bldg., has had plans prepared for the construction of a 2 story, 100 x 160 ft. store and garage on 7th and Central Sts.

CANADA

N. B., Moncton—The Record Fdry. and Machine Wks. will soon receive bids for the construction of a plant to include warehouse, machine and casting shops. Estimated cost $100,000.

Ont., London — The Service Truck Co., Wabash, Ind., will open bids April 30 for the construction of an auto factory, to include three 1 story, 110 x 300 ft. buildings and power house, on Chelsea Green. Estimated cost, $300,000. Private plans.

Ont., London—The Utilities Bd. plans to establish an electrical smelting plant for the manufacture of fittings. Estimated cost, $10,000. E. V. Buchanan, City Hall, engr.

Ont., Ottawa—The Bd. of Control will soon award the contract for the construction of a 2 story, 60 x 123 ft. work shop and garage on Chamberlain Ave. Estimated cost, $60,000. A. J. Macallum, City Hall Engr.

General Manufacturing

NEW ENGLAND STATES

Mass., South Braintree—The Monatiquot Rubber Wks., Hancock St., will build a 1 story rubber manufacturing plant to replace the one which was recently destroyed by fire. Estimated cost, $70,000.

R. I., Woonsocket—Jarratt Bros., Mason St., have awarded the contract for the construction of a 2 story, 80 x 165 ft. addition to their textile mill. Estimated cost, $90,000.

R. I., Woonsocket — The Lafayette Worsted Co., Hamlet Ave., has awarded the contract for the construction of a 1 story, 103 x 170 ft. addition to its worsted manufacturing plant. Estimated cost $50,000.

R. I., Woonsocket—The Leputre Bros. Co. will soon award the contract for the construction of a 3 story, 100 x 135 ft. textile mill on Manville Rd. Estimated cost, $150,000. Private plans.

Vt., Burlington—The Bd. of Trustees of the University of Vermont, plans to build a dairy on campus. Estimated cost, $100,000.

MIDDLE ATLANTIC STATES

N. J., Trenton—The Adamantex Brick Co., 47th St. and Bay Parkway, Brooklyn, N. Y., incorporated with $1,000,000 capital stock, plans to build a brick plant, here.

N. Y., Buffalo—H. J. Hutchins, 93 Elk St., has awarded the contract for the construction of a 2 story, 70 x 100 ft. laundry. Estimated cost, $20,000.

N. Y., New York (Borough of Manhattan)—W. D. Hannan Shoe Co. will alter its 6 story factory at 55 Duane St. Estimated cost, $500,000.

MIDDLE WEST STATES

Ill., Chicago—The Mickelberry Food Products Co., 641 West 47th St., has awarded the contract for the construction of a 1 story, 85 x 125 ft. factory. Estimated cost, $35,000.

Ind., South Bend—The South Bend Bait Co. plans to build two 2 story bait factories on West Colfax St. Estimated cost, $50,000. Private plans.

Mich., Detroit—Friesema Bros., Shelby and Larned Sts., are having plans prepared for the construction of a 3 story, 100 x 100 ft. printing plant on Shelby St. A. Kahn, 1000 Marquette Bldg., Archt.

O., Canton—The Continental Clay Co., Zinninger Bldg., will receive bids about May 1 for the construction of a sewer pipe factory. Estimated cost, including equipment, $350,000. Noted March 3.

O., Columbiana—F. Sebring, Sebring, plans to build a 1 and 2 story pottery plant, here. Youngstown bankers will aid in forming a $450,000 corporation.

Wis., Cedarburg—E. J. Groth plans to build a 2 story, 60 x 200 ft. limestone crusher mill, etc. Estimated cost between $75,000 and $80,000.

Wis., Milwaukee—The Atlas Bread Co., 927 Central Ave., is having plans prepared for the construction of a 2 story bakery. Estimated cost, $150,000. McCormick Co., Inc., Century Bldg., Pittsburgh, Pa., Archts. and Engrs.

Wis., Sheboygan Falls—The Falls Roller Mills Co., c/o E. Gonzenbach, Pres., is having plans prepared for the construction of a 2 story, 60 x 210 ft. roller mill, on Main St. Estimated cost, between $75,000 and $100,000. Juul & Smith, Imig Bldg., Sheboygan, Archts. E. Juul, Imig Bldg., Sheboygan, Engr.

CANADA

Que., Drummondsville — The Butterfly Hosiery Co., Providence, R. I., is having plans prepared for the construction of an addition to its factory, here. Estimated cost, $200,000.

Ont., Ottawa—The Slinn Bread Co. plans to rebuild its bakery on Catherine St., which was recently destroyed by fire. Estimated loss, $125,000

Even with all the precautions taken it is not an easy matter to secure a perfect roll. Sometimes a roll will be found to be out of true when it is placed in the calendering machine; and such a roll quickly makes its defects known, as there will be variations of pressure upon the cloth as the roll revolves and these variations are manifested by streaks upon the cloth. In such cases the roll is reheated and allowed to cool several times and then reground. It is sometimes necessary to repeat this process several times, and occasionally a roll has to be discarded because it will not come true.

The rolls of a calendering machine are usually geared to revolve together, but with slightly differing surface velocities; the differential speed being secured by making them of slightly different diameters, by using differential gears, or both. The relative surface speeds are not uniform for all fabrics nor under all conditions for the same fabric. Neither are all calenders used hot. For a cold calender the rolls would, of course, be finished in a corresponding condition.

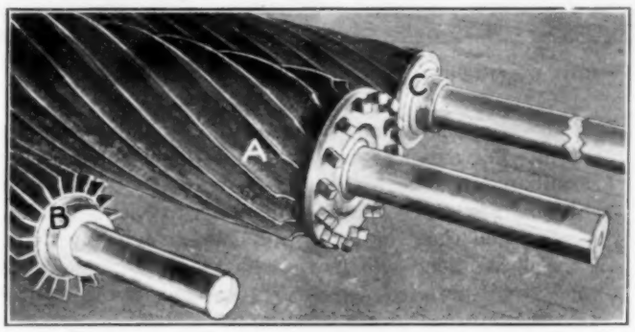


FIG. 10. AMERICAN AND ENGLISH CONSTRUCTION

The roll seen in Fig. 1 is 160 in. long and something over 12 in. in diameter. It is the upper one of the pair that belongs to the partly assembled machine seen in Fig. 2. In this machine the bolt of cloth rests upon the cradle of small rolls seen at the left and the web passes over the sectional wooden roll—called the spreader—to the calender rolls. Passing between these latter rolls, where it is ironed and pressed, it goes to a winding roll at the top of the machine and assumes the form of the original bolt.

FIG. 11. SECTION OF SHEAR BLADE STOCK, ENLARGED

The Spreader Roll

The spreader roll is an ingenious device for keeping the web tightly spread widthwise so that wrinkles may not pass to the calender rolls. The middle section of the spreader, comprising about one-third of its length, is permanently fastened to the shaft and has no movement apart from a rotative one. The outer third at each end is made up of separate slats arranged to slide endwise for the distance of an inch or two, being supported at suitable intervals by spiders in which are milled bearing surfaces to take care of the endwise movement.

Each end section is independently governed by a roller running in the groove of a fixed cam attached to the frame of the machine so that as the whole roll revolves by reason of the web of cloth being drawn tightly over it, the sliding sections upon the upper half of the circumference are continually moving outward toward the end of the roll, the return toward the center taking place during the lower half of its rotative movement when no cloth is in contact with it. The periphery of those parts of the roll that are made up of sliding sections is cut with coarse grooves or serrations resembling file teeth so that as the sections move outward under the cloth all wrinkles are smoothed out and the web evenly spaced just as it enters between the calender rolls.

FIG. 12. A CORNER OF THE BLADE STOCKROOM

Burr Cylinder, or Burr Roll

Another part for a textile machine, the simplicity of which is not apparent until its construction is studied, is that shown in Fig. 4, called a burr picker roll, or simply a burr roll. The burr picker is in the first, or preparatory, class of textile machinery and is usually, though not necessarily used in connection with the preparation of wool fleece for the felting process. Its office is to remove burrs (hence its name) or other undesirable foreign material quite likely to be found in the fleece.

FIG. 13. THE GROOVING MACHINE

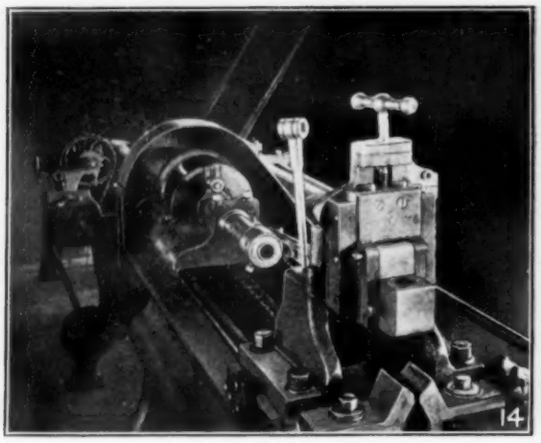


FIG. 14. DETAIL OF HEADSTOCK AND CARRIAGE

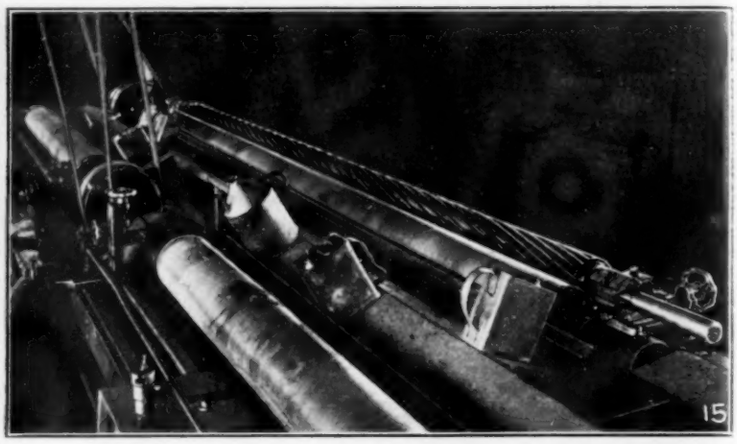


FIG. 15. FINISH GRINDING A "REVOLVER"

The basis of the burr roll is a wooden drum glued up in quartered construction and mounted upon a central shaft provided with cast-iron heads or flanges that are pinned to the shaft. The serrated surface is made up of a large number of rings of sheet iron in the periphery of which notches, resembling the teeth of a circular saw, have been cut.

Notching Rings for Burr Rolls

The manner of cutting the notches in the rings is quite ingenious and involves the minimum amount of waste. Starting with a disk large enough to make a ring for the largest size roll, the teeth are cut by a punch and die in the press to be seen in Fig. 5. In the center of each disk is pierced a triangular hole that fits over the correspondingly shaped stud of the indexing device. This stud is the upper end of a vertical shaft that carries at its lower end a ratchet, operated through bevel gearing from the crankshaft of the press. The distance of the stud from the tools is adjustable to accommodate different sizes of rings.

The press runs very rapidly and the indexing movement is automatic. The operator has only to lay a disk in position upon the stud with the edge under the tools and depress the treadle; holding his hand upon the disk to prevent it from becoming accidentally displaced as it is stepped around the circle. Each stroke of the machine after the first one adds a complete tooth until the cycle is complete and the press stops.

Shearing Off the Ring

The notched disk is then passed to the next operator, who puts it upon a machine similar to the first except that the notching tools are replaced by a pair of shear blades shaped to the circle of the disk which is to be cut. One complete revolution of the disk under these tools shears the ring from the disk and leaves the latter all ready for the notching operation and in turn to become a ring for the next size smaller burr roll.

The shearing operation is shown in Fig. 6 with the press stopped after the disk has made about half a revolution. As each center cut out becomes a disk from which to make a ring for a smaller sized burr roll there is no waste of stock except the corners of the square sheet (which is made round by the same means) and the last center, which has become too small to be used for the smallest diameter of roll.

The complete burr roll is made up of these toothed rings, alternating with plain rings of a smaller diameter, forced over the wooden drum and held by endwise pressure between the two cast-iron heads. The rings are put under compression by means of the screw press shown in Fig. 7, the number of rings to each roll being so calculated that the taper-pin holes previously drilled in the upper head and in the shaft will coincide at the same time that the pressure exerted by the press reaches the predetermined amount.

The Shearing Machine

One of the many finishing processes through which a fabric must pass before it is ready for the market is the shearing, which reduces the "nap" to a uniform length and gives to the surface the smooth and uniform appearance that it would not otherwise possess. The shearing is done by a revolving drum carrying a series of helically disposed blades running against a straight stationary blade. The shearing machine is so constructed that the fabric is drawn sharply over a fixed guide located in front of and below the stationary blade, and as it passes the blade the projecting fibers are swept off to a uniform height, dependent upon the adjustment of the machine, by the swiftly moving blades of the rotating cutter.

"Revolvers" Not Necessarily Firearms

These cutters, called "revolvers" in the shop where they are built, are seldom more than 6 or 8 in. in diameter but are quite likely to be very long in proportion and are a rather difficult proposition to handle by any common manufacturing operation. In Fig. 8 may be seen a 114-in. carpet shearing machine which, as its name indicates, performs this operation of shearing upon carpets or rugs up to 9½ ft. wide.

The machine has many moving parts in the way of rolls, drums, brushes, etc., but these are merely for the purpose of handling the material through the machine; the vital part, and the one that requires the most careful workmanship, is the revolver, seen at *A* near the top of the machine. Though this revolver is supported upon bearings more than 10 ft. apart, has twenty helical blades running its full length, and turns 1,000 r.p.m. against a stationary blade, so carefully is it made and adjusted that it will cut tissue paper cleanly at any part in the length of any blade. This test is regularly applied in assembling the machine and no machine is allowed to leave the floor of its builders until it is perfect in this respect.

In Fig. 9 are shown two of the revolvers: one built

in the shops where the photographs were taken and the other from an English machine, sent in for repairs. Fig. 10 shows an enlarged view of the ends, denoting the difference in construction. The one shown at *A* in Fig. 10 is the English cutter. It is made of heavy iron pipe ground true on the outer surface, and the blades are held in place only by tension, being drawn tightly by the locknuts outside the collars at each end. Both ends of each blade are forged down to a round section and threaded for the nuts. Because of the insecurity of this method of fastening, the blades are often displaced and repairs must be made by inserting collar head screws at intervals on each side of the loose blade.

English Blades Not Fastened to Core

The English construction naturally requires a blade of T-section to furnish a comparatively broad base to bear upon. The angular advance of the helix must also be less than the American construction will permit for the reason that the blades are not, originally, fastened to the pipe. A nick in this form of cutter necessitates the removal of the whole blade and the substitution of a new one or the reforging of the damaged blade.

The blades used in the American construction are of rectangular section and are set into helical grooves planed in a core of solid steel. Blades may be set at any helix angle desired or even parallel with the axis of the core, for the angle of the blade has nothing to do with holding it in place. If a blade is broken by accident, only the broken part need be cut out and replaced, without disturbing the undamaged portion.

Grooves are cut into the core about $\frac{1}{16}$ in. deep (varying somwhat with the size of revolver), and the blades are driven tightly into the grooves. The soft metal of the core is then swaged with a staking tool along the whole length of each blade. At *B* in Fig. 10 is shown one of the American type of revolvers without the protecting collar at the end, and at *C* the same type of blade ready to go in the machine.

The cores, or centers of the American built revolvers are, as before mentioned, solid bars of cold rolled steel, fluted to correspond with the number of blades and the helix angle desired. They may be from 2 to 6 in. in diameter and of any length up to 160 in. Blades may be (and in some forms are) parallel with the center-line, or they may be disposed in a helix at angles that vary from one turn in 77 in. to one turn in 22 inches.

The blades are of composite steel. A strip of high carbon steel is first welded to a backing of softer material and it is then forged and rolled to exact shape and size, as well as to the correct helix angle, before hardening. A section of blade, somewhat enlarged, is shown in Fig. 11. As the blades are very hard and quite brittle, the necessity for forming them before hardening is obvious.

As the revolvers are made in various diameters, lengths, and twists to meet differing requirements, and as only a blade that matches the core in every respect can be used, it follows that a comparatively large stock of the blades must be carried and the blade stock room therefore presents a rather bewildering array to the eye of one who is not used to seeing steel stock in this shape. A photograph of a corner in the stockroom is shown in Fig. 12.

Each twist, or helix angle, is found to be best adapted to some particular fabric. Silk, from which it is necessary to remove only a few loose or projecting fibers, requires a very different form of blade from that used for shearing velvet or carpet, where the shearing machine is depended upon to produce a smooth and even surface.

Obviously the job of putting from 10 to 36 helical grooves in a bar of steel nearly 14 ft. long is not one for any standard machine unless it be a thread milling machine; and a special machine for this purpose was at work long before the thread milling machine became a commercial possibility. It is shown in Fig. 13. Thread milling machines have been tried for this work and found to be unsatisfactory for the reason that they will leave the groove slightly larger at the top than at the bottom, making it impossible to hold the blade firmly.

The grooving machine has the characteristics of both lathe and planer without quite being either. The bed is in the shape of a lathe bed and it carries a footstock and at least part of a headstock. The usual form of shear on a lathe bed is replaced by a pair of deep V-grooves, common enough on any small planer, and the lathe carriage or planer table, whichever it may be, slides in these grooves, being pulled back and forth by a chain running over sprockets at each end of the bed.

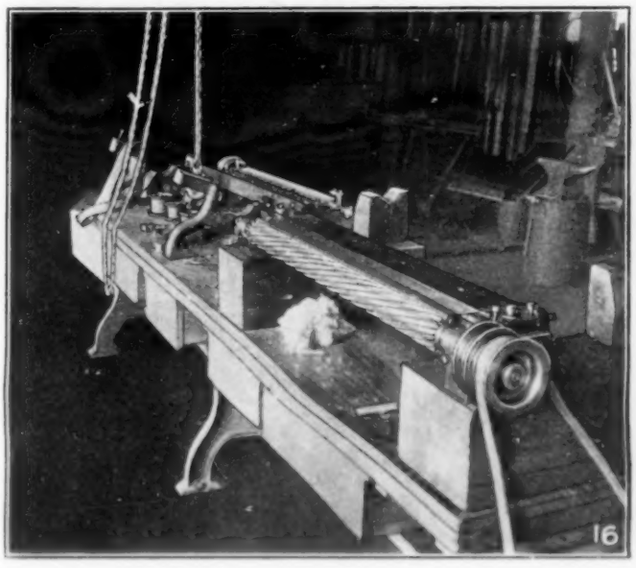


FIG. 16. THE FINAL LAPPING

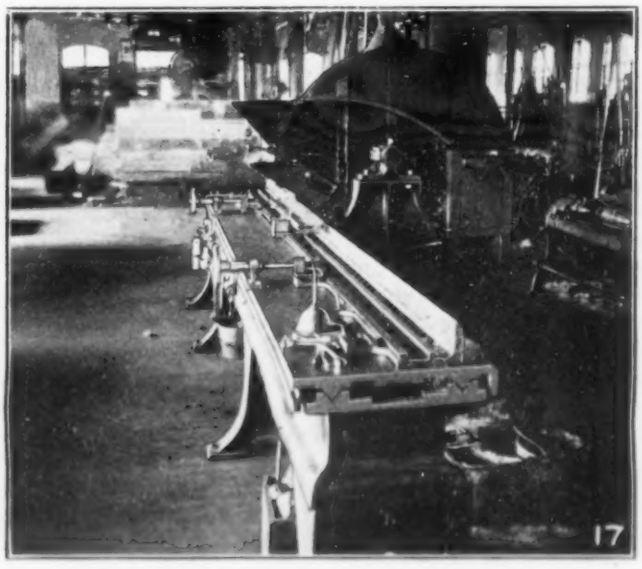


FIG. 17. "GRINDING" THE STATIONARY BLADE

Evolution of an "American Machinist" Article — VI

At last we arrive at the Editor's desk, and the old joke about it being hard to interview the editor doesn't go in the office of the *American Machinist*. Anybody desiring to consult him can readily do so and will always find him congenial. He is here shown giving each article, in page form, his final O. K. This is the final editorial step and after a page is O. K.'d by the editor it is sent to the composing room and regarded as a closed incident. Like all editors, he is always as busy as the proverbial one-armed paper hanger. His duties are manifold and of such nature that they would make a very interesting story in themselves.

United States Council of National Defense Issues Final Report of War Industries Board

Encouragement of permanent intimate combinations or associations of industry under government supervision, involving a radical change in the present attitude of the government toward such groupings, is recommended in the final report of the United States War Industries Board just completed by Bernard M. Baruch, who was the board's chairman. This is one of the conclusions the board came to as the result of its successful direction of industry during the war in conjunction with the temporary associations of the various industries evoked by the war necessity. It is held that great public benefits in the way of prices and abundance of goods, resulting from economies in production and distribution, are capable of being effected through the mutual co-operation of members of industrial groups, and that the present governmental policy of enforced isolation and costly competition is not conducive to the general welfare.

But as the same power born of association that makes for potential benefits may also make for potential injustices, it is recommended that there be created some sort of government agency which shall supervise such associations, both for the purpose of promoting their beneficient possibilities and checking their opposite potentialities.

A concise recommendation is also made for the maintenance of a skeleton organization along the lines of the War Industries Board which by reason of its form and its peace-time contact with industry would be capable of immediate expansion and action in the emergency of another war. In this way the experience gained in the World War may be permanently capitalized. "One is led to the thought," Mr. Baruch says, "that in a similar emergency there ought not alone to be a mobilization of man power but of things and of dollars."

The report is issued in book form from the Government Printing Office, and is entitled "American Industry in the War." The preface quotes the brief report made by Mr. Baruch to President Wilson at the conclusion of the board's general work in December, 1919, in which a full and detailed history was promised. It describes the book—which contains about 150,000 words—as "an analysis and narrative of the War Industries Board, whose function it was to supervise the industries of America that the energies of each should, as far as practicable, supplement those of all others, and that all should contribute to the limit of their combined ability to one common purpose—the winning of the war."

"Communism Must Go—If Russia Is to Live"

"There is just one way for Russia to be reconstructed, and that is for Communism to fall. If Lenine wants to give in, as some people would have you believe he has apparently given in, he has just one step to take, the re-establishment of private property and the re-establishment of reward for individual effort." These are the words spoken by Captain Hugh S. Martin, of the Military Intelligence Division of the U. S. Army, at a meeting of the Merchants Association of New York, held at the Hotel Astor on April 6.

Captain Martin spent three years in Russia and is credited with the distinction of being the only loyal American admitted to the deliberations of the Bolshevik government. The Captain gave a graphic description of the rise of Bolshevism and its attending disorder and bloodshed.

"Bolshevism," he said, "is the spectacle of an insignificant minority attaining power by deception and holding by bullets that power against the will of an overwhelming majority."

"They tell you that Petrograd is dying because we blockaded Russia. A greater lie has never been spread upon a credulous people. Russia is dying today—the industry is gone—because Bolshevism has destroyed individual initiative and human ambition."

The Captain then went on to give his deepest impressions concerning Bolshevism. He declared that the four most important things he noticed about this new order were the ease with which the Bolshevist agitator manages to corrupt and poison the mind of the mass; the methods used by the agitator in organizing his adherents; the capacity of the Bolshevist for destruction, and the peculiar philosophy of the Bolshevist—or his method of converting or bewildering those who come into contact with him.

In closing Captain Martin said, "Bolshevism is not a Russian experiment, a Russian institution; it is essentially internationalism. It admits it cannot live in Russia alone, and unless it can spread its insidious doctrines throughout the world and set up a world soviet republic it has got to fall in Russia. They tell you that Bolshevism is changing. I tell you that Bolshevism will change only when Bolshevism falls."

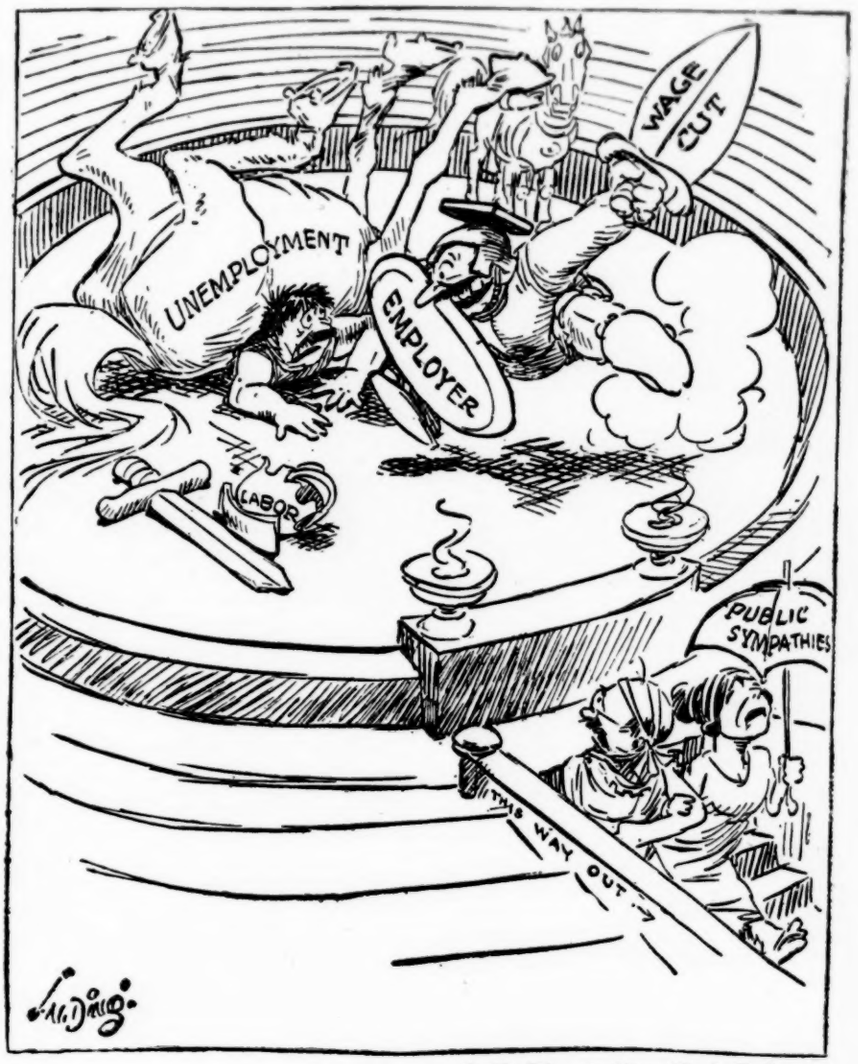
The other speaker of the day was Sir Paul Dukes, who fought in the Red Army during the revolution in Russia in 1917. Later, as a British Secret Service attaché, he spent some time investigating the theories and practices of the Soviet régime in Russia.

Sir Paul told of some of his experiences during the bloody days of the revolution. He narrated these incidents in an amusing way, but without losing sight of the lesson or the idea which he wished to bring out. On the future of Russia he had this to say: "The fate of Russia, you know, is intimately bound up with the fate of the rest of the world. Of course, no one can say when

we shall be once again in touch with that great country, a country which in a hundred years has raised itself to be on a par with the rest of the nations of the world.

"America is the greatest democracy in the world, and there is a great part for America as well as for my own country to play in the restoration of Russia, and in the teaching of Russia, how to use, how to employ this great gift of freedom which temporarily they have allowed to slip out of their hands. And if you do that, if you help us, if we work together in teaching the Russians how to do this thing, how to profit by liberty, and what duties it carries with it, I assure you, knowing the Russian people as I do, that they will not be lacking in their gratitude."

Look Out! Laurels Won in That Kind of Victory Will Only Lead to a New Challenge



J. N. Ding in New York Tribune

Personals

R. B. HUBBELL has resigned as sales manager for Churchill-Morgan-Crittsinger, Inc., to resume his former position with the Heald Machine Co., Worcester, Mass.

J. A. COWLES has severed his connection with the McVicker Engineering Co., Minneapolis, Minn.

A. D. ARMITAGE was re-elected president of the Whitman Barnes Co. of Akron, Ohio, at the annual meeting of the stockholders. Other officers elected include: C. E. Sheldon, chairman of the board of directors; A. B. Hall and R. S. Carter, vice-presidents; E. A. Fisher, secretary and treasurer; S. H. Tuttle, assistant secretary. Directors other than officers elected were: George Hill, C. B. Raymond, F. A. Siberling, A. H. Cummings and J. R. Nutt.

JAMES R. LOWE has been made general sales manager of the Harrisburg Foundry and Machine Works, Harrisburg, Pa., having previously been sales engineer with the Midwest Engine Co., Anderson, Ind.

E. L. JOHNSON was re-elected president and general manager of the Rubber City Tool and Templet Co., Akron, Ohio, at the annual meeting here last week; W. A. Skelton, of Cleveland was named vice-president. Other officers are: W. D. Ernsberger, treasurer; Mrs. J. H. McWade, secretary; J. H. McWade, director.

ALBERT J. ROMER, formerly mechanical engineer of the New Departure Manufacturing Co., Bristol, Conn., and more recently chief engineer and designer of the Northway passenger car of the Northway Motors Corporation, Natick and Boston, Mass., has formed the Romer Motors Corporation, Boston, Mass. A factory for the manufacture of passenger cars will be erected at Danvers, Mass.

CLARENCE M. DAVISON, until recently manager of the service station Aslop Motor Corporation, Richmond, Va., is now general superintendent of the Poole Engineering and Machine Co., Baltimore, Md.

GEORGE H. KENDALL is now with the Jefferies-Norton Corporation of Worcester, Mass. He was formerly in the standards department of Norton Co. of Worcester.

CARL W. BETTCHER has been appointed sales manager of the Eastern Machine Screw Corporation, New Haven, Conn. Mr. Bettcher will devote his attention especially to the expansion of sales of H. & G. die heads.

FRED W. CEDERLEAF has resigned as chief engineer of the Sparks-Witherington Co., of Jackson, Mich., and has joined the Zeigler Manufacturing Co. as works engineer.

C. L. SMITH has joined the staff of the Moore Iron Works, Inc., 1600 E. Missouri St., El Paso, Tex., in the capacity of sales manager. The company specializes in all sorts of structural steel and cast iron work.

G. S. MARTINDALE has severed his connections as resident engineer for the General Motors Corporation, St. Louis, Mo., to become works engineer for the Champion Coated Paper Co., Hamilton, Ohio.

E. T. SPIDY has resigned his position as production engineer of the Angus shops of the Canadian-Pacific Ry., to take a position as assistant superintendent of the Dominion Engineering Works, Montreal, Canada.

C. H. PETERSON, formerly with the Iron Mountain Co., Chicago, Ill., is now vice-president and general manager of the Viking Corporation, manufacturers of automatic fire protection apparatus, Hastings, Mich.

LOUIS T. KLAUDER has resigned his position as construction engineer for the Philadelphia Rapid Transit Co. and will enter the consulting engineering field, specializing in plant design and construction.

E. E. DAVIS, manufacturing superintendent of Gilbert & Barker Manufacturing Co., Springfield, Mass., recently resigned his position with the company.

S. A. HUGHES, assistant to the works manager at the plant of Gilbert & Barker Manufacturing Co., Springfield, Mass., recently resigned his position with the company.

J. F. CARATINI of the general sales department of the Gilbert & Barker Manufacturing Co. of Springfield, Mass., recently returned to this country after nearly a year spent in Porto Rico and the Dominican Republic in the interests of his company.

WILLIAM ROBERTS, formerly connected with the engineering department of the Rolls-Royce of America, has established offices at 457 Main St., Springfield, Mass., under the name of the Engineering School of Drawing. He will specialize on production and efficiency work and designing of tools and special machines.

GUSTAVE BATTIN, for a number of years Paris sales engineer for the Allied Machinery Co. of Paris, has been elected a director of the C. E. Carpenter Co., Société Anonyme of Paris, dealers in American machine tools. Mr. Battin will look after sales in the Paris district.

J. W. STANNARD, secretary-treasurer of the American Auto Parts Co. of Detroit, Mich., has been elected first vice-president of the Industrial Cost Association.

H. S. PECK, controller of the S. K. F. Industries, Inc., has been made national director of the Industrial Cost Association.

JOHN R. COMSTOCK, assistant superintendent of the blast furnaces of the Steelton, Pa., plant of the Bethlehem Steel Co., has resigned to become assistant to the general manager of the M. A. Hanna Co. of Cleveland, Ohio, the latter firm marketing ore and pig iron. Mr. Comstock is a former resident of Mechanicsburg and entered the Steelton plant nine years ago after graduating from Stevens Institute.

Obituary

WILLIAM HENRY RUNGE died at his home in Seneca Falls, N. Y., March 10, after an illness of three months. His death was not wholly unexpected by his friends who knew of the unsuccessful attempt last Spring to relieve him by a surgical operation. Mr. Runge was born in Syracuse, N. Y., March 13, 1867, but had been a resident of Seneca Falls, N. Y., the greater part of his life.

Born into what would today be considered a large family and having the advantage of but a common school education, he was obliged early in life to take up the battle for a livelihood. Denied the advantages of a university training and education, which with his natural endowments, would doubtless have aided in placing him among the foremost mechanical engineers of this age, by his untiring industry and devotion to his chosen vocation and liberal application of common sense with which he was richly endowed, he overcame many of the handicaps with which he started in life. The Golden Rule was his code, perhaps without being conscious of it. He very naturally won for himself a large circle of friends whose loyalty could never be questioned.

For practically thirty years he was an important member of the organization of the Seneca Falls Manufacturing Co., Seneca Falls, N. Y., and during the past fifteen years served as mechanical engineer. During this period he was the originator of many improvements in the lathe design, as is evidenced by the fourteen or more U. S. patents that have been granted him covering many novel and valuable features of lathe design.

Although Mr. Runge had specialized in lathe design, he was nevertheless a versatile mechanic and was unsatisfied with anything that engaged his attention until he had carried it at least one step nearer perfection. His finer sense of the appropriate would not permit him to identify himself with anything impractical or mediocre. Fabrication of parts interested him no less than the design, and consequently many improved tools and methods were introduced by him for the production of tools and machinery. He quietly and persistently followed his ideals, worked out his conceptions and left his impress on things, always for the better.

He is survived by his wife, Elizabeth Garling Runge of Seneca Falls, N. Y., and two brothers, Fred W. Runge of Painted Post, N. Y., and Ernest A. Runge of Paterson, N. J.

HENRY ATWATER, a prominent manufacturer for the past forty years in Bridgeport, Conn., died at the Bridgeport Hospital March 19. Mr. Atwater was 77 years old. He came to Bridgeport in 1879 to start the Bridgeport Malleable Iron Works, now a subsidiary of the Eastern Malleable Iron Co. of Naugatuck, Conn., and he was a director and also secretary of that concern up until 1906, when he retired from the business. Mr. Atwater is survived by his wife and one son, Fred Atwater, secretary of the Columbia Nut and Bolt Co. of Bridgeport.

ELIE MILLETT, inventor of the Millett-Core Oven and also founder of the Millett Brass Co., now the Harley Co. of Springfield, Mass., died at his home in Springfield on March 19 after a long illness. Mr. Millett was 69 years old and had been a resident of Springfield for the past fifty years. He was well known throughout the East in manufacturing circles.

ALBERT H. WOLF of New York, a well known engineer, died at Atlantic City, N. J., on March 13. Mr. Wolf had been active in many railroad and marine engineering enterprises, prominent among which was the construction of the Eads bridge acros sthe Mississippi River at St. Louis.

CHARLES SILBERZAHN died at his home at West Bend, Mich., on March 12. He was 92 years old. In partnership with his son he conducted a foundry and machine shop business at West Bend. He was well known in that section of the country as a machine builder and designer.

ADDISON STEVENS HODGES, for two generations a leading figure in the foundry and hardware business in New England, died last week at Somerville, Mass., in his ninetieth year. He was engaged in the foundry business for seventy years, first at the Wheeler foundry in Worcester and later in Hyde Park, Chelsea, Somerville and Lynn, Mass.

ANDREW J. CORCORAN, founder and president of A. J. Corcoran, Inc., Jersey City, N. J., died on March 9. He was a pioneer in the foundry and machine building industry in New Jersey.

Forthcoming Meetings

The National Metal Trades Association will hold its annual convention at the Hotel Astor, New York, on April 20 and 21. Homer D. Sayre, Peoples Gas Building, Chicago, Ill., is secretary.

The fifth annual convention of the American Gear Manufacturers Association will be held in Cincinnati, Ohio, April 27, 28, 29 and 30.

The ninth annual meeting of the Chamber of Commerce of the United States will be held at Atlantic City, April 27 to 29, with headquarters at the Traymore Hotel.

The annual meeting of the American Welding Society will be held in the Engineering Societies Building, 29 West 39th St., New York, on April 28.

The Society of Industrial Engineers will hold its national convention in Milwaukee, Wis., on April 27, 28 and 29. Geo. C. Dent, 327 So. La Salle St., is business manager.

The National Foreign Trade Council will hold its eighth annual convention in Cleveland, Ohio, on May 4, 5, 6 and 7. J. G. Hammond, care of the Council, 409 Park Bldg., Cleveland, is secretary.

A triple convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will be held in Atlantic City, N. J., May 16, 17 and 18, 1921, with headquarters for all three associations at the Marlborough-Blenheim. F. D. Mitchell, 4106 Woolworth Building, New York, is secretary of the last-named association.

The spring meeting of the National Association of Manufacturers will be held in New York, May 16, 17 and 18 at the Waldorf-Astoria Hotel. The headquarters of the association is at 30 Church St., New York City.

Announcement is made that the regular spring meeting of the National Machine Tool Builders Association will be held in Atlantic City, N. J., on May 19 and 20. Headquarers will be at the Traymore Hotel. Ernest F. Du Brul, 817 Provident Bank Bldg., Cincinnati, Ohio, is general manager.

The spring meeting of the American Society of Mechanical Engineers will be held at the Congress Hotel, Chicago, May 23-26. Calvin W. Rice, Engineering Societies Bldg., 29 West 39th St., New York, is secretary.

The Society of Automotive Engineers, 29 West 39th St., New York announces that its summer meeting will be held at West Baden, Ind., on May 24 to 28 inclusive.